Reliability Society

N E W S L E T T E R http://www.ieee.org/society/rs

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Editor:
Dave Franklin
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Dr. Robert J. Loomis, Jr.

President's Message

This past year, my first term of Presidency, has been an exciting year. We started out the year by filling a couple of AdCom vacancies with new members. Bruce Bream, after many years of serving as the Newsletter editor, asked to be replaced. We thank Bruce and wish him well in his new assignment. The good news is that our Asst. Editor Dave Franklin, has agreed to continue as Editor. This issue is the second issue under Dave's watchful eye. Bob Loomis, new AdCom member, tackled two new tasks - Newsletter Asst. Editor and Society webmaster. He transferred the data from our previous webpage onto the IEEE server and maintains the page. The Transactions have also had a change of crew earlier this year - Martin Wortman has settled in as Editor and Joanne Bechta Dugan is the Senior Associate Editor.

The technical committees were re-organized this year and two new committees were formed. Several committees are very active - from generating standards to producing videos. The year ended with a visit to our Tokyo Chapter. I would like to thank the Tokyo Chapter for their invitation and hospitality, especially to Koichi Inoue and Yoshinobu Sato for listening to my presentation not once, but twice. Thanks also to the University of Kyoto.

What will 1998 bring? We have a new slate of elected AdCom members including

Mr. Joe Caroli
Dr. Joanne Bechta Dugan
Mr. R. H. Gauger
Mr. Vincent R. Lalli
Dr. Orlin D. (Bud) Trapp
Dr. Timothy A. Rost

Philip Tsung and Shuichi Nitta are joining the AdCom to replace two members who had to resign.

The new elected officers are:

Mr. Ken LaSala continuing as VP Technical Operations
Mr. Dennis Hoffman as VP Membership
Dr. Orlin D. (Bud) Trapp as VP Meetings
Paul Gottfried continuing as VP publications

Marsha Abramo has agreed to take over as Chapters Coordinator. We will see less of two AdCom members this year as Tom Weir and John Adams retire. We wish both a happy retirement.

I am looking forward to 1998 - with this dynamic group of people and the activities planned, it will be another exciting year.

Loretta Arellano
Reliability Society President

(continued on page 5)

Editor's Column

Membership in the Reliability Society brings with it many advantages. Some of them are the Transactions, this Newsletter, sponsored conferences and symposia, local Chapter meetings and presentations, access to other IEEE resources, and NETWORKING.

Networking is to me the most beneficial of the advantages. The reliability practitioners I have met are always willing to provide guidance in finding the correct method/process to solve problems in their related specialties. I am sure you too have helped or been helped by fellow Reliability Society members.

Each member should introduce a colleague to the society so that the colleague may participate in the advantages of membership, and increase all our opportunities to network.

Best Wishes for the New Year,
Dave Franklin
Editor

Reliability Society Newsletter Inputs

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The schedule for submittals is:

Newsletter	Due Date
January	November 19
April	February 26
July	May 28
October	August 27

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All copy that contains graphics or special fonts must be camera-ready or delivered on computer disk and be received by the due dates indicated.

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RELIABILITY SOCIETY OFFICERS

Chapter Activities

Boston Chapter

Last quarter in Boston was full of events: we had a change in the Chapter's leadership, a very successful fall lecture series, and two excellent monthly meetings. Philip W. Tsung resigned from the Chair position because he moved from Massachusetts to Michigan. He has been working on consulting assignment in Michigan since March 1997 and finally decided to "make a break" from Boston. We enjoyed working with Phil, and we appreciate his contribution and leadership. We wish him the best of luck and good success in his professional endeavor and personal life. The current Boston Officers list is:

Chair, Giora Kedem, 3Com Corporation - giora_kedem@3com.com

Vice Chair, Jeff Clark, MITRE Corporation - jclark@channel1.com

Secretary , Warren Snow, Axil Computer - warren.snow@axil.com

Treasurer, Don Markuson, Peritus Software Services - d.markuson@ieee.org

Our Fall Lecture Series was named "Focus on Physics" (of Failure), and took place four consecutive Wednesday evenings during October at the MITRE Corporation, in Bedford, MA. The location and the facilities were very convenient and we are thankful to MITRE Corporation. The Lecture Series was organized and carried out by Gene Bridgers, M/A-COM Corporation. Besides presenting himself, Gene was able to gather presenters from the excellent companies in the area who contributed their knowledge, experience and time. We had presentations by several experts from M/A-COM Corporation, Allen-Bradely/Rockwell Automation, 3Com Corporation and others.

We had an introduction to focus on physics, recommendations on defect classification method (patent, latent, wear-out, and design margin), discussions about practical defect control strategies, recommended process for defect identification, discussions on some MTBF and market metrics and discussions about several typical failures and defects.

The November monthly meeting was combined with a tour of the of EMC Reliability Lab, in Hopkinton, MA. EMC Corporation is a highly successful manufacturer of large memory systems for mainframe, Unix, and mid-sized computer systems, with features such as multi-terabyte storage capacities and remote mirroring. These memory systems are critical and often central elements for the daily operations and revenue streams of their users, and high reliability of these systems is vital. To meet this reliability requirement, EMC has invested in state-of-the-art test facilities and they currently employ close to one hundred large ESS chambers worldwide.

We had an introductory presentation of EMC's test approach to qualification, reliability and ESS strategy. Then, we had a tour in the facility and received additional explanations in the reliability lab centered around fourteen HALT and HASS environmental chambers. In this lab components and boards of new products, and systems are HALTed and qualified and HASS profiles are developed, to produce high quality designs and achieve the required end system reliability. We were very impressed by the commitment to reliability and customer satisfaction and the professionalism that Kevin Grandlund, the Engineering Test Manager and his staff demonstrated. After the tour we better understood how EMC Corporation became so successful: "Reliability" is a key word and a key principle at EMC.

The December monthly meeting topic was "Estimating the Reliability of Electrical Connectors", and we had an excellent presentation by Dr. Robert S. Mroczkowski, AMP Incorporated, Principal and Director, Connector Reliability Technology. The meeting was at the Papa Razzi Restaurant in Wellesley and was combined with our annual Holiday party. This was a special Past Chairs meeting with introduction of the Past Chairs to the audience by Avery Hevesh. Avery, Past Chair in 1969-1970, recently joined the Boston AdCom again in the steering committee. He recognized the Past Chair's contribution with his special sense of humor and brought back some old memories and laughter. We had good attendance with 14 Past Chairs attending, representing 17 years of chairmanship (As Avery Hevesh, said, "We recycle them"). The attending Past Chairs were:

Year(s)	Name
1965 - 1966	Charles Saraglow
1969 - 1970	Avery Hevesh
1971 - 1972	Don Dawes
1973 - 1974	Donald V Simpson
1989 - 1990	
1976 - 1977	Gene Carrubba
1979 - 1980	Mark Snyder
1981 - 1982	Wil Aubert

In the picture from left to right, Standing: Gene Bridgers, Don Dawes, Wil Aubert, Jake Bajakian, Gene Carrubba, Don Markuson. Sitting: Brian McQuillan, Donald V Simpson, Sid Gorman, Avery Hevesh, Charles Saraglow

Avery Hevesh is introducing the Past Chairs. Standing, recognized for their contribution are Brian McQuillan, and Gary Kushner (right) while Millie Hevesh is amused by her husband's remark. The pictures were taken by Giora Kedem, current Chair.

1984 - 1985	Gary Kushner
1991 - 1992	
1985 - 1986	Sid Gorman
1986 - 1987	Gene Bridgers
1987 - 1988	Jake Bajakian
1990 - 1991	Don Markuson
1995 - 1996	
1991 - 1992	Gary Kushner
1994 - 1995	Brian McQuillan

Our next major event will be the Spring Symposium, that will be held in the Holiday Inn, Boxborough, MA, on April 23, 1998. This year's topic is: RELIABILITY PROCESSES, TOOLS, AND TECHNIQUES "State of the Art Reliability Engineering for the Next Century".

We welcome new presenters and we encourage you to visit our web site for details about attending the symposium. Please contact the Symposium Chair: Harry Saraidaridis, Lucent Technologies, saraidaridis@lucent.com, Phone: (508) 490-5758, or Program Chair: Joe Dzekevich, 3Com Corporation, joe_dzekevich@3com, Phone: (508) 229-1761.

The Spring Reliability Symposium (SRS) web site is at:
http://www.channell.com/users/ieee/srs98cfp.html

Giora Kedem,
Chair, Boston Chapter
Giora_Kedem@3com.com

Cleveland Chapter

The Cleveland Chapter had two meetings in this period.

Our September meeting was "Knowledge Management: How to build and manage it." Mr. Thomas Stewart and his panelists from the International Institute of Learning Video conference explained opportunities and challenges that knowledge management offers to our organization. Business pioneers are finding surprising ways to put real dollars on the bottom line as they discover how to measure and manage the ultimate intangible: knowledge. We had a packed house with standing room only. The program was excellent in content and enjoyed by many.

The October meeting was a tour to Bettcher Industries. Mr. Frank Watson, Deputy Vice President, took the group on an interesting two hour tour. Bettcher Industries, Inc., was originally founded in 1944 by Louis A. Bettcher under the name of Bettcher Dieweld Company. Mr. Bettcher started his Company with a capital of $800 in a small machine shop in the old meat district in the city of Cleveland Ohio. Bettcher Dieweld's first products were jigs, fixtures, tools, dies and special machinery. In 1954 the Whizard Bone Trimmer was introduced. The glove, originally designed to protect meat cutter's hands from cuts and abrasions, opened up a whole new marketing arena in general industry related to protective wear. The division was sold to Wells Lamont in 1996, as they represented the best opportunity to take the product line to the next level in successful world wide marketing.

In 1995 the company introduced the AIRSHIRZ. This revolutionary new tool designed to replace conventional scissors in the poultry industry also has general industry applications. This tool combines all the infinite control advantages of regular scissors with the power pneumatics. By introducing this tool, Bettcher brought a portion of the poultry processing industry into the twentieth century. The company earned the prestigious, "1995 INDUSTRIAL ENGINEERS EXCELLENCE IN PRODUCTIVITY IMPROVEMENT" award, for the favorable impact this tool has on the human factor in a high production atmosphere. With unlimited versatility through a wide variety of interchangeable blades, the marketing horizons for this tool are excitingly wide. From an $800 investment in 1944 to today's recognition as a world leader in food machines, food research, protective wear, and cutting edge technology in ergonomics BETTCHER INDUSTRIES CONTINUES ON THE MOVE TO NEW SUCCESS! This was a very interesting tour.

We have offered to help the RS ADCOM with the International Software Symposium. NASA has a large interest in software performance assurance and this can help our members get the training they need in mission assurance. We in Cleveland would like to see our society support the needs of our members in additional areas of mission assurance: Maintainability, system safety, quality assurance, logistics support, human factors, software performance, system effectiveness as well as reliability. Right now, where can a member go to get this information in the IEEE? Please let us know what you think.

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

Vincent Lalli, Chair
Vincent.R.Lalli@lerc.nasa.gov

Dallas Chapter

We have had a successful beginning to the program year with 4 talks on a wide range of reliability topics. In those 4 talks we have been fortunate to have had 2 IEEE fellows speak. That's not a bad ratio!

In September we had a great presentation by Doug Stolk and his son on "Failure Analysis of Electronic Components: Analytical Techniques for Solutions" or "Who Killed Mr. Widget". We all put on our "sleuthing" hats to solve a failure analysis problem that was presented . Doug is the President of Metallurgical Engineering Services Corporation. The

October meeting was focused on the "Reliability of Plastic Encapsulated Microcircuits (PEMs)" by Dennis Spencer from Raytheon TI Systems." This is one technique that has been used to help estimate the reliability of PEMs in various operating environments.

The year finished with a bang with presentations by 2 IEEE fellows. Dr. Ayman Shibib from Lucent Technologies talked with us in November about "Smart Power Integrated Circuits and Technologies in Telecommunications Applications." There was great interest in this presentation, especially due to the large telecommunication presence in this area. The December program was also interesting even though it was on a completely different topic. Dr. Norman Schneidewind, from the US Navel Postgraduate School, spoke on "Introduction to Software Reliability with an Example from the Space Shuttle." It was a great introduction to this topic, and it was something that anyone who operates a PC and has had it lock up (or worse!) could relate to!

The next program in January is on the reliability of a new technology that Texas Instruments is pioneering called the Digital Micromirror Device (DMD) to be presented by Mike Douglass of Texas Instrument, Inc. The title of this presentation is "DMD Reliability: Exceeding Expectations - or - "How do you make a million mirrors move a trillion times without failure?"" Each DMD device consists of over 500,000 individually addressable micromirrors and has been used in such diverse products as film-like projectors and photographic-quality printing. Reliability testing has taken on a new dimension in this area with operating life tests demonstrating greater than 100,000 operating hours and over 1 trillion mirror cycles. That's right, a trillion! Should be interesting.

Best Regards,
Tim Rost, Chair
Phone: (972) 995-9035
e-mail: t-rost@ti.com

Philadelphia Chapter

At our September meeting Mrs. K. Mauchly Antonelli presented "ENIAC and The Early Years of Electronic Computing". The talk focused on the personalities and accomplishments of Eckert and Mauchly and described what each man brought to the design of ENIAC. The completed ENIAC was successfully demonstrated to the public in February 1946.

Dr. R. Yantorno talked on "Bandwidth: Infinite demand and Finite Supply, and the Problems with Voice and Audio Transmission". He explained that one would expect that as technology development increases there should be an increase in the quality of our communication systems, however, just the opposite has happened. With the introduction of new communication techniques have come new problems that have to be overcome. Can we expect an increase in the quality of these new communications techniques with respect to voice and audio transmission? What does the past tell us about the future, in terms of quality of service with respect to these two types of media? Are there new methods that might give us some insight into how to overcome the present problems and anticipate future problems with voice and audio communications? When can we communicate with anyone, at anytime, from anyplace? Will our voice or audio retain high quality while being processsed. These were some of the questions that Dr. Yantorno expanded on at the meeting.

At the October meeting Mr. Charles F. Baxter presented "National Energy Strategy— From Oil Crisis in 1973 to Present, and Where Are We Going?". The discussion covered the types, from wood and coal through to nuclear and renewables (wind, solar, hydro, and geothermal), Consumed in the United States over the last three decades with enphasis on security, efficiency, environment, and foundation (education and dissemination of information).

Dr. Hollis F. Ryan spoke on " Air Traffic Control Automation for the FAA: The Center-Tracon Automated System". He explained that the Federal Aviation Administration (FAA) is developing a number of computer systems to automate functions that air traffic controllers perform in directing air traffic. One of these systems is called the Center-TRACON Automation System, or CTAS. Currently, limited function prototypes of CTAS are operating in the field. Full-scale development is preceeding on the complete system. A brief description was given of how the FAA directs air traffic in the U. S., and what Centers and TRACONs are and how they are used. Then CTAS functions of predicting, scheduling, and selecting aircraft routes was described along with an overview of CTAS algorithms and their implementation.

Fulvio E Oliveto
Philadelphia Section
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Singapore Chapter

(ED/Reliability/CPMT Joint Chapter)

1997 has been a busy one for the chapter. Apart from the usual technical talks, we have also been running two series of short courses, one on IC Failure Analysis & Reliability (with 11 short courses) and the other on Electronic Packaging (with 6 courses). But the two big events this year has been the two conferences, which we organized in Singapore. These were the 6th International Symposium on the IC Failure Analysis & Reliability (IPFA) held in July 97 and the 1st Electronic Packaging Technology Conference (EPTC) in October 97. This report will give a brief summary on the 6th IPFA and a report on the EPTC will be given on the next occasion.

IPFA has been running biennially for 10 years. This year it was held at the Raffles City Convention Center, Singapore from July 21-25, 1997. It is organized by the Singapore ED/Reliability/CPMT Joint Chapter in co-operation with the Center for Integrated Circuit Failure Analysis & Reliability at the National University of Singapore and the Institute of Microelectronics. It is also technically co-sponsored by the IEEE Electron Device Society. The Proceedings can be obtained via the IEEE Open Plan for Conference publications.

This year we had about 180 participants listening to 41 oral presentations and 14 poster papers from 12 countries. The participants came from (in descending number of participants) Singapore, Malaysia, USA, Japan, Korea, France, Taiwan, Germany, Belgium, Ireland, Philippines, Indonesia, Finland, Nether-

Tokyo Chapter

I proudly announce that we began to operate our Chapter's own Web Site in Kyoto University since October 15th, 1997. The address is as follows:

http://yang.kuaero.kyoto-u.ac.jp/index_e.html (in English)

http://yang.kuaero.kyoto-u.ac.jp/ & http://yang.kuaero.kyoto-u.ac.jp/ (in Japanese)

Please come visit our Web site from time to time. Announcements on our host events as well as approved events will be posted on the home page on the web as soon as they are determined. In cooperation with our Chapter members, I finished establishing our own Internet Mail System. If you have any information valuable to our members which you would like to distribute among them, please contact me. I hope that the new Chapter's own Web Site and the new Internet Mail System will help us to serve our members more quickly and in a more friendly way than ever.before.

Koichi Inoue
Chairman
inoue@vib.kuaero.kyoto-u.ac.jp

AdCom Meeting Minutes

Albuquerque Marriott
Albuquerque, NM
October 4, 1997

Attendance:

Name	AdCom Position
Marsha Abramo	AdCom member
John Adams	VP Membership
Loretta Arellano	1997 President
Dick Doyle Jr.	Past President
Bill Everett	IEEE CS Guest
Sam Keene	Video Tutorial Chair
Paul Gottfried	VP Publications
Dennis Hoffman	VP Meetings
Ken LaSala	VP Technical Operations
Bud Trapp	Member-Chapter Coordinator
Tom Weir	Sr. Past President
Rick Wells	Guest

Loretta Arellano called the meeting to order and went over the agenda. The minutes of the July 19, 1997 AdCom meeting were reviewed and accepted

Philip Tsung was appointed to AdCom by Loretta Arellano and approved by AdCom to replace Jon Curry who resigned due to business conflicts.

Dick Kowalski's tresurer's report was read and approved. We expect to end the year with a surplus. The 1998 budget was approved and sbmitted to the IEEE in September.

The next AdCom meeting was scheduled on Sunday January 18, 1998 in Anaheim, California in conjunction with the RAMS Symposium and will include an AdCom awards banquet. The AdCom will be preceded on Saturday January 17, 1998 by a meeting of the Technical Operations Committee. The spring AdCom meetiing will be held on March 29,1998 in Reno, Nevada in conjunction with the IRPS Symposium and will include a Chapters Award banquet. The July meeting is tentatively planned to be held in the Washington DC area.

A feasibility advisability study for a stand alone, Computer Aided Engineering (CAE) workshop, previously held in conjunction with RAMS should be sponsored.

John Adams, Membership VP, will be retiring in January 1998, and all wished him well. He requested that a replacement be found for him, a difficult task. On going membership activities include putting together a RS brochure to promote membership in the society, establishing a membership retention program, and a new member incentive program.

Publications VP, Paul Gottfried reported that we need to encourage the submission of more good papers for the Transactions. **All members should consider submission to share their experience with the reliability community.** Electronic publication of the Transactions is being investigated.

Ken LaSala, Technical Operations VP, was pleased to announce that J. P Rooney has assumed the chair of the International Reliability Committee and that J Zamanali will assume the chair of the Nuclear Reliability Committee. In addition Rick Wells has joined the Definitions and Standards Committee, and Marsha Abramo has resigned as chair of the Reliability Physics Committee, but will remain a member. **The Vehicular Committee and the Energy Committee both need chairpersons, please send nominations of willing experts in these fields to Ken LaSala.** The TQM committee will be desolved.

Company Recognition Awards will be made to NASA and Rome Labs for their contributions to the field of reliability.

Dick Doyle, Jr. Past President, reported the status of the Reliability Society Five Year Plan.

The Video Program report was given by Sam Keene. The Reliability Society has produced three videos thus faron the

Next AdCom Meeting Agenda

Our January Tech Ops (Jan. 17, Saturday) and AdCom (Jan. 18, Sunday) meetings will be held in Anaheim, California. **If you have any comments on the subjects listed or other issues you would like the AdCom to address please contact any of the officers listed on page 2, or the editor of this newsletter.**

Call to Order,
Agree to Agenda
Minutes Approval
Treasurers Report
Presidents' Reports
Meetings
Membership
Dues Structure change
Publications
  Newsletter
  Society Webpage
Technical Operations
Junior Past President's Reports
  Long Range Planning
  Medal and Service Awards
Senior Past President's
Video Program
Report on Chapter
Report PACE Activities
Report EDUCATIONAL
Report on Transactions
Report on Technical Activities
Old Business
IRPS Status
Process for developing standards
New Business
Adjourn
AdCom Awards Dinner

subjects of **Software Reliability, Concurrent Engineering, and Human Performance and Reliability**. AdCom has approved development of videos on Software Safety and Failure Analysis. Other subjects under consideration are Process Signetures for Semiconductors, Semiconductor Failure Analysis, and HALT Testing. There is a possibility that other societies may be interested in participating in the production of these new videos.

Bud Trapp lead a discussion on the Chapter Awards Criteria and Rules, and reported that the Chapter Chairperson internet address list is being updated**. Please send Bud your Chapters current address.**

The Status Of Reliability Engineering Technology

A report to the IEEE Reliability Society January 1998

Introduction

Reliability engineering is becoming increasingly important as we all become increasingly dependent on advanced technology. Consumers want technology, and they want technology that works. In today's society, advanced electronic equipment is used in telecommunication, medical equipment, transportation and similar critical functions. Home electronics such as cellular phones, and home computers with access to the Internet are rapidly becoming as common as TVs. Offering technology, without addressing reliability, is the safest way to put a company out of business. In 1997 consumers in large numbers were happy because of the availability of inexpensive access to the Internet but unhappy about purchasing access to a busy-signal. At the 1997 Annual Reliability and Maintainability Symposium (RAMS) a frustrated participant shared his experience with the poor reliability of the laptop computers used in his company, but worse yet, telephone inquiries to the manufacturer's hotline had resulted in nothing but ignorant answers such as "what is reliability?" Reliability engineering addresses our need to rely on technology and advanced equipment.

In traditional reliability textbooks, "reliability" is defined in a most quantitative fashion such as the "probability that a product will perform its intended function (without failure) for a given period of time under stated conditions." In today's world, reliability engineering has evolved to include a variety of other issues, some of which are more qualitative than quantitative, and some more difficult to measure the success of than others. Current trends suggest that reliability engineering is becoming focused on methods aimed at preventing failures rather than simply describing or modeling the occurrence or probability of failures. This report represents the continuing efforts of the IEEE Reliability Society in determining the most important trends and developments in reliability engineering technology. Each technical committee provides an annual technology assessment report within the committee's field of expertise, and the following report is compilation of these efforts. While some issues are naturally subjective, the idea of including input from a variety of experts in the reliability field as much as possible, is an attempt to avoid bias.

The "Year 2000 Problem"

One reliability problem that will be of most concern over the next few years, according to contributor Anthony Coppola, is the so-called "Year 2000 Problem", which is expected to have major impacts on software that uses calculations of time elapsed between two dates. Computer programs using the common mm/dd/yy format (utilizing only the last two digits of the year) will incorrectly interpret year 2000 as year 1900 resulting in errors in calculations involving two dates with one being before and the other after the year 2000. There are no accurate predictions of the exact cost of correcting this problem, but some sources have estimated the impact in tens to hundreds of billions of dollars. The biggest problem encountered in debugging the software is that typically a program will not display an error mes-

sage when an error of this type occurs; it will simply report an incorrect result. In debugging the software, each use of the mm/dd/yy format must be identified and changed in every single sub-routine, which may be a rather time-consuming process. The article "Are You Ready For The 21st Century?" by Bryce Ragland published in the March 1996 issue of CrossTalk, the Journal of Defense Software Engineering, provides more details on this issue.

DoD Acquisition Reform /Cancellation of Military Standards

A few years ago the U.S. Secretary of Defense issued a memo abandoning the use of military/government reliability standards in all DoD acquisitions in favor of commercial "performance-based" standards. Today many of the canceled military standards are being converted to military handbooks. The intent is that these handbooks shall serve as guidelines rather than requirements.

On-going efforts in developing suitable replacement standards is being made by various standard organizations and professional organizations, including the IEEE, but there is still a lot of work to be done. Contributor Joe Caroli reports on the progress on six ongoing IEEE reliability standardization projects.

Due to the large number of organizations involved in developing new commercial standards to replace the military standards, the Reliability, Maintainability and Supportability (RMS) partnership was formed in 1996. The mission of this partnership is to coordinate the generation of these new standards, and avoid duplication and/or inconsistencies between the various works in progress. Also, the "Primer for International Reliability and Maintainability Standards" was released in 1997 by the US Air Force Rome Laboratory. This is a very useful document providing summaries of 88 potential replacement documents, and other background material. For more information contact Joe Caroli at the Air Force Research Lab (email carolij@rl.af.mil).

EU Directives

The ISO 9000 dominates as the international Quality Standard. Certification by third party auditor is required for all manufacturing sites exporting to the European Union (EU.) This has caused a booming business for quality system registrars, contributor John P. Rooney reports. Five years ago, with the approaching deadline of December 31, 1992, many companies were attempting to become appropriately registered, from ISO 9001 for a Quality System for full design, production, installation and servicing, down to ISO 9003, for just final inspection and test. Third party registrars had lengthy lists of clients waiting to be surveyed and registered. Of interest to the reliability practitioner is the fact that ISO 9000 quality system standards rarely mention reliability.

Other EU directives, Rooney reports, have included the EMC Directive, the Low Voltage Directive and the Medical Devices Directive. Therefore a broad group of international manufacturers, ranging from electronics to rotating machinery and to medical devices, has had to comply with the requirements of the EU. In the near future, IEC 300-2-1 on Dependability will be promulgated. When IEC 300-2-1 is accepted internationally, the EU is likely to make the standard's requirements a necessity for doing business in the EU.

ISO 9000

With the cancellation of MIL-Q-9858, the military, NASA, and the Departments of Commerce, Energy, and Transportation have now endorsed ISO 9000. A potential problem, according to contributor Anthony Coppola, is the proposed merger of ISO 9000 audits with ISO 14000 (environmental management system.) A number of people believe tying the two standards together is unwarranted. This combined with the lack of a voice in the ISO 9000 revisions have prompted the US automakers to decide that future versions of QS 9000 (the quality standard of among others Ford, GM and Chrysler) will not include the complete text of ISO 9001 as the present version does. This may create some problems in accrediting QS 9000 auditors.

AS9000, the aerospace version of the ISO9000, was officially released by the Society of Automotive Engineers (SAE) in May 1997. This standard was developed by a committee formed by the Aerospace Industries Association (AIA) and the American Society for Quality (ASQ) with representatitives from AlliedSignal, Allison Engine, Boeing, General Electric Aircraft Engines, Lockheed-Martin, McDonnell Douglas, Northrop Grumman, Pratt & Whitney, Rockwell-Collins, Sikorsky, and Sunstrand. The new standard contains the complete ISO 9001 with 27 clarifications or qualifiers and 8 notes added to the existing twenty elements of ISO 9001. A preliminary version of AS9000 was released in October 1996 as ARD9000 (Aerospace Resource Document). It should be noted that, as of now, the major aerospace companies have not yet required third-party registration as with the QS-9000 requirements. More information is available from the SAE web site www.sae.org or its affiliate Performance Review Institute (PRI) www.pri.sae.org. Also the December issue of Quality Digest (available online at www.qualitydigest.com) contains a good overview article about AS9000 by Lee C. Bravener.

Use of Digital Circuitry in Aerospace/Avionics Applications

An important issue, according to contributor Kevin Krych, is the increasing use of complex digital circuitry in safety critical systems and the implications regarding safety assessment. In the aerospace/avionics industry, the use of ASICs, microprocessors, gate arrays, and other highly complex digital devices is seen as a means to provide increased functionality at lower cost with higher reliability and safety. Krych states that "... as an industry (aerospace), we are limited by our ability to analyze, assess and certify the safety/reliability of such complex systems. Add to this the projected increase in air traffic and the required decrease in accident rate to maintain a constant "public perception of safety" regarding air travel. The result is that we have a need to include greater digital complexity in safety critical systems while attaining significantly higher levels of safety and reliability. Reliability engineering technology needs new methods of reliability analysis, reliability assessment, and reliability assurance that will provide input to a practical safety assessment process able to support the new, higher levels of complexity and safety."

Concurrent Engineering

The Concurrent Engineering (CE)/Integrated Product Development (IPD) is alive and well, according to contributor Dennis Hoffman. The industry is embracing IPD teams for product development. Product development is seen as a process that can be documented and improved. CE capability improvement models and assessment techniques have been developed by multi-industry groups and consulting firms, which are facilitating the implementation of these techniques. These assessments provide a road map for improvement. The IEEE has developed a video tutorial on CE which is presently being marketed, and a new CE oriented book Concurrent/Simultaneous Engineering (Methods, Tools, & Case Studies), authored by Paul G. Ranky (CIM Limited, Guildford, Surrey, England, ISBN 1-872631-04-5) has just been published. The book is supported by a CD-ROM and contains numerous case studies.

Reliability and Maintainability Computer Aided Engineering (CAE) applications are making great strides as they are becoming more integrated and much more user friendly, Hoffman reports. The integration of tools and databases greatly improves data handling and operability while greatly reducing the data entry burden. Electronic interfaces between the design CAE systems and Reliability and Maintainability CAE applications are becoming more wide spread. The boundaries between UNIX and Windows/NT based applications are diminishing, and opening the door for platform and data access. Perhaps the biggest strides are the multiple requirement applications, which are beginning to surface. These "system" approaches help estimate and trade-off product attributes such as performance, reliability, and cost against one another, striving toward a more optimal solution very early in the design cycle, when the product design can be cost effectively impacted.

Reliability in Medical Technology

The FDA has raised the bar a bit higher for all medical device design and manufacturing companies. The latest federal register for medical devices (21 CFR Parts 808,812,820 - Medical Devices - Current Good Manufacturing Practices) has significant new requirements for design procedures, which include unique definitions of verification and validation of a medical product design, as reported by contributor John Adams.

"This is interesting in that some time ago the military recognized that reliability and safety had to be designed into the product. Now, years later, the military is not very active in this philosophy and the FDA has picked up the banner," Adams reports.

Even though these are new requirements from the FDA, they are not totally new to most international medical device companies. IEC and the European regulatory agencies have emphasized the importance of design procedures for several years. The FDA is catching up while also attempting to become more uniform with the other world wide regulatory agencies. In the long run this is good for everybody for the following reasons: ·

The customers, i.e. medical practitioners and their patients, win by the delivery of better, safer, and more reliable medical products. The manufacturers, even though they are upset now, will benefit by standardization of their design processes to produce better designs, which usually results in higher sales and higher profits. The better the design, the easier and less expensive the manufacturing becomes with higher yields and lower costs.

Human Performance Reliability

The interest in Human Performance Reliability continues to increase according to contributor Ken LaSala. After years of intensive efforts in the military and nuclear power fields, the interest in human performance reliability now appears to be expanding into the commercial aviation and medical equipment fields. In general, product vendors have become more sensitive to the interaction between their products and humans because of some very substantial product liability settlements. The number of human-oriented design tools continues to increase due to new or improved products from both government organizations and commercial vendors. The rapidly increasing use of computers has made the human-computer interface a popular subject for research, training, and design analysis.

The U.S. Federal Aviation Administration (FAA) has published or is publishing three new products in the human factors engineering area. While these strictly are not human performance reliability items, they will assist designers in enhancing human performance reliability. The first product is the Human Factors Design Guide, which is a comprehensive reference tool for human engineering design principles and practices. The second product is a tool entitled Human Factors in Acquisition Requirements and Planning (HARP.) This describes the process by which human factors engineering is accomplished in a system acquisition program, and identifies the human factors link to the products of each acquisition phase. The third product is entitled Human Factors Job Aid and is a desk reference for human factors integration during system acquisition. It contains an overview of the FAA human factors process in system acquisitions, and eight chapters describing functions required for a successful human factors program. A "How To" section in each chapter provides the steps to complete the function. Checklists are included to assist in executing and implementing a human factors program.

The Idaho National Engineering and Environmental Laboratory's (INEEL) focus on applying human performance and human reliability knowledge and methods as an integral element of system design and development is expanding from the nuclear domain to military weapons systems and aircraft, offshore oil and shipping operations, and commercial aviation operations and aircraft design. INEEL has developed an integrated approach and a framework for human performance analysis, human reliability analysis (HRA), operational data analysis, and simulation studies of human performance to the design and development of complex systems. This approach was recently tested in the NASA Advanced Concepts Program Structured Human Error Analysis for Aircraft Design. This program resulted in the prototype software tool, Tool for Human Error Analysis (THEA), for incorporating human error analysis in the design of commercial aircraft maintenance tasks. THEA builds upon a methodology called, Framework

Assessing Notorious Contributing Influences for Error (FRANCIE), to model human tasks for airplane maintenance, identify potential performance shaping factors that contribute to error, and to estimate the likelihood of error combinations to lead to serious consequences. In addition, THEA facilitates the evaluation of different design options to determine those that will be most effective in reducing the likelihood and consequences of maintenance errors. THEA is designed to make available the expertise of human reliability experts for airline designers and procedure writers, during their development tasks. INEEL currently is working to apply the framework to the development of advanced Air Traffic Management systems as part of NASA's Advanced Air Transportation Technologies program.

Recent industrial process control activities have focused on the application of human cognitive modeling to process control design, in order to ensure that operator actions planning and execution will be matched to physical process dynamics. As an acknowledgment of human factors importance, several universities and consulting companies offer human factors and human reliability analysis training courses for managers and reliability engineers. Most of the training is either in traditional human factors or nuclear-derived HRA techniques, but there is an increasing number of courses offered on human-computer interface design.

Nuclear Reliability

The Nuclear Regulatory Commission (NRC) is making increased use of Probabilistic Risk Assessment (PRA) and Probabilistic Safety Assessment (PSA) applications in regulatory requirements. Contributor Jalal Zamanali reports that, even though the nuclear utility industry has been promoting the use of PRA methodologies to enhance nuclear safety, only in few areas of regulatory issues has PRA been used reasonably well in the past. Traditionally the NRC has regulated the nuclear facilities based on deterministic approaches. To assess the potential use of PRA for improving the effectiveness and efficiency of the deterministic regulations to control nuclear power plants operating risks, The NRC initiated an effort to identify and evaluate alternative risk-based approaches that could enhance and extend their traditional deterministic approaches. The risk-based regulations represent one of several initiatives sponsored by the NRC for improving the safe operation of nuclear power plants. The Probabilistic Safety Assessment Standard Review Plan is developed by the NRC staff to serve as a template for judging the quality and acceptability of PRAs for risk-based regulation applications, Zamanali reports. To implement the risk based regulations consistently, effectively and efficiently standard PRA techniques, tasks and frameworks are needed. Without these standards regulators would have difficulties evaluating, benchmarking and comparing risk measures for similar plants.

Reliability Prediction

Recent articles in the technical journals suggest that classical "Mil-Hdbk-217 based" prediction is "out", and "reliability physics based" prediction is "in". What impact this has on the way the industry will do business in the future, however, is not really clear. In the March issue of IEEE Transactions on Reliability Ralph Evans wrote in his editorial, " ... there are two extremes in the reliability prediction field: 1) Mil-Hdbk-217 type advocates who believe all the numbers to the last significant-figure, and 2) Reliability physics advocates who believe that there is an equation for the world and have discovered/researched a large portion of it.. Both groups are doing the reliability business more harm than good. "

The fact remains that the technology of electronic devices is changing faster than accurate statistical failure data can be generated, and faster than handbooks on reliability parameters can be updated. Also, field failure data tend to be dominated by failures that are not the result of the components' physical properties, as discussed in the next section. Thus, there is a need for constantly improving our knowledge about mechanisms causing component failures, and then make appropriate design-changes to avoid failures where possible. But there is also a need to use statistical/probability models to model the "unknown." Since the choice of statistical model is not always obvious, and since the results can vary orders of magnitude depending on which model is selected, there is a strong need for performing "what-if" analyses to assess the results' sensitivity to the choice of model. Reporting reliability predictions without some measure or assessment of its accuracy is as meaningless as reporting public opinion polls without reporting the margin of error.

Robust Development and Reliability Testing

Several contributors express the view that failures of electronic systems are dominated by failures due to design problems or "special causes". Contributors Samuel Keene and William Denson report that "... a few percent of all the Field Replaceable Units (FRUs) contribute nearly all of the system hardware failures." Failures of this nature can be attributed to specific, resolvable causes, and thus, they can be eliminated through design changes.

Since the majority of system failures stem from "special cause" problems, it seems most appropriate to explicitly account for these problem drivers. Keene and Denson are presenting a paper describing a "New Process Grading Reliability Model" at the 1998 Annual Reliability Symposium (RAMS). They suggest among six other sources "system (mis-) management" as a major contributor of failures.

Contributor Finn Jensen raises a similar point. According to his experience, more than 90% of equipment field failures (not attributed to wear-out) are caused by "freak" failure mechanisms, e.g. power surges, excessive mechanical loads etc. He reports "robustness testing" as a new tool for identifying and removing process weaknesses by identifying margins for loads that are particularly critical in the customer environment. Increased "product robustness" is achieved by increasing the design margins most likely to be exceeded in the customer environment. This approach is currently being pursued by several European industries. Jensen's recent book Electronic Component Reliability (J. Wiley, 1995) provides more detail on robustness testing.

Contributor Bill Wallace notes that there is a continuing or growing interest in reliability growth testing as described

in military handbooks and standards (e.g. Mil-Hdbk-189 and Mil-Std-781). While these publications are still in use, work on a national standard update to replace Mil-Hdbk-189 is nearing completion, and Mil-Std-781 is currently being converted to a handbook.

Commercial off-the-shelf (COTS) Software

Today's biggest issue in software engineering, according to contributor Irv Doshay, is to deal with the risk and hazard potential in the use of commercial off-the-shelf (COTS) software. Much of such software was prepared with very limited application objectives, but the knowledge of those limitations is rarely transferred to the ultimate user of the related hardware. One approach toward minimizing risk in the use of COTS software is to prepare a set of rules that, if correctly followed, will significantly minimize or preclude erroneous interpretations as may be related to categories of input data. The ultimate intention is the incorporation of those rules in an Expert System model that can be applied to the candidate COTS software in conjunction with its associated hardware platform.

Reliability and Availability Models of New Telecommunications Technology

Calculation and analysis of the reliability/availability of, e.g., a broadband ATM network which will carry data, video, and interactive multimedia TV and narrowband telephony traffic, is a current complex technology example. Contributors Hank Wolf and Michael Ball report three major issues:

Mixed Traffic Types (data, video, multimedia TV, telephony)

Quality of service (e.g. reliability, availability, system integrity, privacy, security, etc.) varies with the type of traffic considered in the model. The characteristics of the traffic impacts system reliability, e.g. re-routing traffic is difficult if you are transmitting an object (e.g. an image) that requires high bandwidth, while small objects (e.g. text file) can be re-routed more easily.

The Network Hierarchy

The network is built of technology layers and includes fault tolerance at lower layers, e.g. network-oriented and transport levels, but not necessarily at the upper application-oriented layers. The need for fault tolerance, at the upper layers when lower level fault tolerance is provided, is not clear.

System Complexity

Software, hardware, and control system design coupled with any potential for design errors within these elements, creates a complex system. In addition, as new system elements replace older elements, adding new functions and capabilities, the model must change to reflect the modifications.

Wolf reports that developing reliability/availability models of new technology with discipline tools, is a challenge for a practitioner who is a novice in the reliability disciplines and an expert in new telecommunication technology. The model developers need to become an "expert" in network reliability analysis, and must be able to build a reliability model quickly and accurately. They need materials to understand the underlying mathematical fundamentals, methods, and software for testing and validating the results of their modeling activities.

Emerging Technology and Components

Contributor Dave Franklin predicts that reliability engineering will emerge as a vibrant and dynamic field attracting many new engineers. New scientific methodologies are emerging as necessitated by the DoD Acquisition Reform discussed earlier. Components and systems, delivered off-the-shelf based on new performance-based standards do not have known pedigrees like components and systems built within the limitations of the military specifications and standards process. While this has removed restrictions from the design engineers, it has greatly increased the challenge to reliability and safety assessments of both hardware and software.

New compounds used in component manufacturing continue to fill specialized needs, but improvements in silicon technology and the low cost of silicon show it to be the material of choice for most applications for the next ten years at least, Franklin predicts.

Compiled by

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Call for Papers

Qualityand Reliability Engineering International

Paper are requested for two special issues.

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The Second will be on "Accelerated Stress Screening and Environmental Stress Screening". Papers are requested by May 1, 1998. For details contact:

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Call for Papers

ISSRE'98 Preliminary Call for Papers

The Ninth International Symposium on Software Reliability Engineering

Paderborn, Germany, November 4-7, 1998,

http://adt.uni-paderborn.de/issre/

Sponsored by IEEE Computer Society and Reliability Society, and Organized by the Committee on Software Reliability Engineering of the IEEE Computer Society and Technical Council on Software Engineering

The role of software is expanding rapidly in many aspects of modern life, ranging from critical infrastructures, such as transportation, defense, and telecommunication systems, to workplace automation, productivity enhancement, education, health-care, publishing, on-line services, entertainment, etc. Given the potentially costly impact of software failures for many of these applications, it is important to have sound methods of engineering reliable software as well as accurate methods of quantitatively certifying software reliability.

ISSRE'98 seeks to bring together practitioners and researchers from around the world to share the latest information and know-how related to all areas of software reliability engineering for a broad range of applications. The theme of the symposium is "Globalization: Breaking Barriers - Theory meets Practice - East meets West".

Submissions should report promising new research breakthroughs, but especially welcome are those that help gauge the state of SRE practice. What are the challenges facing your industry in developing reliable software and what SRE methods appear to work in practice? What data collection and analysis methods have you used and what were the consequent benefits in terms of improved reliability? Contributions are expected to advance the state of the art or to shed light on current best practices and to stimulate interaction between (and among) researchers and practitioners. Topics of interest include, but are not limited to:

- Methods of developing reliable software, including management methods and rigorous specification, design, and implementation techniques.
- Data collection and analysis for software reliability assessment
- Software reliability models
- Testing and verification for software reliability measurement
- Software safety
- Fault-tolerant and robust software
- SRE tools, education, and technology transfer methods
- Software reliability standards and legal issues

Paper Submissions can be in the form of papers, experience reports, industry track abstracts, panel proposals, tutorial proposals, and tools fair proposals.

Regular Papers should not exceed 20 pages, including figures and text (typed with 1.5 spacing and 12 point font). Papers published, accepted for publication, or submitted elsewhere are not eligible and will be rejected without review. The cover page must include (1) the title, (2) the names, complete mailing addresses, e-mail, telephone, and fax numbers of all authors, (3) the name of the contact author, (4) an abstract not exceeding 250 words, and (5) a list of around 5 keywords. The first page of the paper should have the paper title and the beginning text of the document. If the paper is accepted, one of the authors is expected to pre-register for the symposium and present the paper at ISSRE'98.

Experience Reports are intended to provide exposure to practical experiences

With the application and conduct of software reliability engineering methods, models, and tools. The contributors should submit an abstract and a 5-10 page description of the experience or case study, and a one page summary of the project for a short presentation at the conference. The paper should be clearly identified as an experience report.

Please submit an abstract (250 words maximum in plain ASCII text) and a list of keywords to either one of the Program Chairs, before March 1, 1998 to enable proper referee assignment.

For additional details and submission requirements contact the program chairs:

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New IEEE Video

on "Concurrent Engineering Perspectives: Concepts to Success"

This video is presented by Dr. Samuel Keene, Performance Technology; Nick Krull, Storage Technology Corp.; and Donald Reinertsen, Reinertsen and Associates. Dennis Hoffman, Texas Instruments, Systems Group, served as technical editor. The video is sponsored by the IEEE Reliability Society and IEEE Educational Activities organization.

Concurrent engineering is a synergistic approach to product development in a process-oriented engineering environment. Concepts and methods are introduced that will help you avoid pitfalls and speed your robust products to the marketplace. In this video, you'll learn about these high impact development concepts and methods, currently in practice within industry today. Top experts in concurrent engineering have designed this course to deliver practical information in a way that will enable you to apply these techniques immediately. This video will help you realize shorter product development cycle times, make speedier program decisions, maintain program focus, and keep diversions at bay.

Dr. Samuel Keene, a Fellow of IEEE with broad industrial experience, is extensively published and is an international presenter and consultant in the fields of improved development, assurance, and product optimization strategies.

Nick Krull is an Advisory Engineer at StorageTek Corp. Nick shares his first hand experiences on the IBM Proprinter development team. This IBM team reduced manufacturing time from 30 minutes to 2 minutes, increased reliability fourfold, and reduced parts count by 50%.

Don Reinertsen is President of Reinertsen & Associates, a consulting firm specializing in product development process, management effectiveness, and efficiencies. He is the co-author of the successful book, Developing Products in Half the Time, which has sold over 50,000 copies.

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1998 IEEE-USA Professional Activities Conference

"Preparing for the New Millennium"

Phoenix, Arizona, September 4-7, 1998

The 23rd Annual IEEE-USA Professional Activities Conference will be held at The Pointe Hilton Resort at Squaw Peak in Phoenix, Arizona, over Labor Day weekend, September 4-7, 1998. The theme of the conference is "Preparing for the New Millennium."

You are invited to submit abstracts for review. Abstracts must be received by February 1, 1998, and should not exceed 500 words. A statement regarding the presentation technique that will be used, (e.g., tutorial, case study, interactive workshop, or poster session), must accompany each abstract. Hard copy of abstracts should be mailed to:

IEEE-USA
Attention: PACE
1828 L Street N.W., Suite 1202
Washington DC 20036

Writers whose abstracts are selected for presentation will be notified by February 20. Final papers must be received by May 1, 1998, in hard copy and on disk. Papers will be printed in the 1998 IEEE-USA Professional Activities Conference Proceedings.

Topics

The conference offers an opportunity to explore a wide range of professional and career issues of interest to industry and engineering professionals. Presentations will include, but not be limited to, the following general topic areas:

- Career Planning: Developing and maintaining a competitive career

- Career preservation
- 360 performance evaluation and career analysis
- When and how to bail out. Professional Skills Management: Interpersonal skills
- Time management
- Personal marketing
- Communication skills
- Language skills
- Building personal quality with TQM
- How to conduct performance evaluations
- Building and maintaining influence in a casual world
- Personal etiquette
- Negotiating. Professional Networking. Personal Microeconomic Management Systems: Financial planning
- Retirement planning
- Medical planning. Entrepreneurial Skills. Influencing and Interacting with Customers: IEEE leadership/constituent relationship
- Increasing the value of IEEE membership
- How to get employers to support IEEE activities.
- Mentorship: Finding a mentor Being a mentor.
- Applied Strategic Planning (for IEEE or the workplace): Career forecasting
- Quality positioning (Baldrige/ ISO/SEI). Organizational Ethics and Diversity. Influencing Public Policy. Community action
- Government education
- Public awareness.

Sessions

The conference program will include tutorials, plenary sessions with keynote speakers, concurrent workshops, and posterboard sessions. Some of the workshop and plenary topics will be targeted to engineers with ten years or less of professional experience; papers written specifically for this audience are welcomed. Registrants may earn continuing education units (CEUs) from the International Association for Continuing Education and Training (IACET) for conference participation.

Additional Information

For additional information on IEEE-USA, consult our Web site:

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For additional information on the 1998 IEEE-USA Professional Activities Conference, contact:

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STANDARDS A SPECIAL BARGAIN

We in the Reliability Society are particularly interested in standards. They play a major role in our field of work and require us to adhere to the rules specified by these standards. Now we can participate more in this activity by becoming a member of the IEEE Standards Association.

As a premium for being a founding member of the IEEE-SA (Standards Association), those who join during the balance of 1997 will receive a FREE copy of the new IEEE Standards Reference Database: An Enhanced Version of the IEEE Standard Dictionary of Electrical and Electronics Terms on CD-ROM - a $175 value!

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While the cornerstone of the new organization will continue to be the current standards-setting process and the IEEE Standards Board activities, the IEEE-SA will open up new program opportunities to those society activities and industry initiatives requiring changed methods and reduced time to market for their standards-related documents and resulting products.

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By: Richard L. Doyle
Junior Past President,
Reliability Society

Conference Calendar

Preliminary Program
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March 30, 31, April 1,2, 1998 • Reno Hilton • Reno, Nevada

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For more information on presentations or registration contact the IRPS at http://www.irps.org.

Program

Monday, March 30, 8:00 a.m. - 5:00 p.m. TUTORIALS Chair: R. Wachnik, IBM Vice-Chair: W. Howell, IBM

Morning Session
(8:00 a.m. - 11:30 a.m.)

1. Recent Advances in Silicon Device Reliability—P. Fang, AMD (8–9:30)
2. Scanning Probe Microscopy for IC Failure Analysis—Y. Strausser, Digital Instr./A.Majumdar, Univ. of Calif., Berkeley/C. Williams, Univ. of Utah/ W. Mertin, Univ. of Duisburg (3 h)
3. Nitrided Oxides in CMOS Technology: Past/ Present/Future—B. Maiti, Motorola (8–9:30)
4. Survey of MEMS Processes & Failure Mechanisms—W. Tang, JPL/C. Muhlstein/S. Brown, Failure Analysis Assoc. (3 h)
5. Recent Advances in Multilevel Metallization Reliability—M. Small, Martin Small Assoc. (10–11:30)
6. Dielectric Reliability Physics Using SPM— R. Ludeke/H. Wen, Thomas J. Watson Re-search Center (10–11:30)

Afternoon Session
(1:30 p.m. - 5:00 p.m.)

7. An Overview of IC Failure Analysis—T. Barrette, Gatefield Corporation (3 h)
8. Thermal Effects in Interconnects—K. Bannerjee/ W. Hunter/W-Y Shih, Texas Instruments (3 h)
9. Flip Chip & Ball Grid Array Packaging—R. Master, AMD (3 h)
10. Hot Carrier Degradation in Submicron CMOS Technologies: Problems & Possible Solutions—R. Bellens, Alcatel Telecom (3 h)

Monday March 30, 7:30 p.m.
WORKSHOPS Chair: Eric Snyder Sandia Technologies Please indicate on the Advance Registration form which one of the following workshops you plan to attend. (Rooms to be announced)

1. Plasma Damage. Moderators: C. Cheung, Lucent/N. Bui, AMD/T. Brozek, Motorola
2. Meeting the Failure Analysis Challenges of the Sematech Roadmap. Moderator: E.I. Cole, Jr., Sandia National Laboratories
3. Product Functional Reliability. Moderators: W. Ellis, IBM/J. Okamura, Toshiba/D. Douse, IBM
4. Ultrathin Oxide Characterization and Reliability. Mod- erator: P. Chaparala, National Semiconductor
5. Reliability & Performance Issues in Advanced Metal-lization. Moderators: T. Sullivan, IBM/M. Dion, Harris Semiconductors
6. Hot Carriers. Moderator: J. Tao, AMD
7. Wafer Level Reliability. Moderator: M. Webb, Intel
8. Micro-Electro-Mechanical Systems, Micro-Nano Tech-nologies Reliability for Space Flight Applications. Mod- erator: R.A. Lawton, JPL
9. Ball Grid Array Packaging. Moderator: B. Freeman, AMKOR ANAM
10. Electrostatic Discharge. Moderators: C. Duvvury, Texas Instruments/L. Avery, Sarnoff/J.W. Miller, Motorola
11. New and Current Issues and Applications of Focused Ion Beam. Moderator: Scott Wills, Texas Instruments
12. Scanning Probe Microscopy. Moderator: P. Tangyunyong, Sandia National Laboratories

Tuesday, March 31, 8:15 a.m. — Plenary Session

SYMPOSIUM OPENING—General Chair: A.N. Campbell, Sandia National Laboratories; Technical Program Chair: J.E. Klema, Motorola **Keynote:** The Reliability Challenge: New Materials in the New Millenium – Moore's Law Drives a Discontinuity—J. England, Texas Instruments

Microelectromechanical Systems

1.1 (Invited) MEMS: A Whole New World of Capabilites; A Whole New World of Reliability Issues—R.S. Payne, Cyrano Sciences Corporation

1.2 Lifetime Estimates and Unique Failure Mechanisms of the Digital Micromirror Device (DMD)—M.R. Douglass, Texas Instruments

1.3 How Micro Electro Mechanical Systems (MEMS) Fail—S.L. Miller/M.S. Rodgers/G. LaVigne/J.J. Sniegowski/D.M. Tanner/ K.A. Peterson, Sandia National Laboratories

1.4 The Effect of Frequency on the Lifetime of a Surface Micromachined Micro-engine Driving a Load— D.M.Tanner/W.P. Eaton/N.F. Smith/D. Bowman/ P. Tangyunyong/K.A. Peterson/W.M. Miller, Sandia National Laboratories

Dielectrics

1.5 Enhnced Dielectric Breakdown Lifetime of Copper/Silicon Nitride/ Silicon Dioxide Structure—K. Takeda/K. Hinode/I.

Oodake/N. Oohashi/ H. Yamaguchi, Hitachi, Ltd.

1.6 Switching Behavior of the Soft Breakdown Conduction Characteristic in Ultra-thin (nm) Oxide MOS Capacitors—E. Miranda/R. Rodríguez/ M. Nafría/J. Suñe/X. Aymerich, Universitat Autònoma de Barcelona

Tuesday March 31, 2:00 p.m. — Parallel Session A

Dielectrics

2A.1Disturbed Bonding States in SiO 2 Thin-Films and Their Impact on Time-Dependent Dielectric Breakdown—J.W. McPherson/ H.C. Mogul, Texas Instruments

2A.2 Deep-Trap SILC (Stress Induced Leakage Current) Model For Nominal and Weak Oxides—S. Kamohara, Hitachi/D. Park/C. Hu, University of California-Berkeley

2A.3 Constant Current Charge-to-Breakdown: still a Valid Tool to Study the Reliabiity of MOS Structures?—T. Nigram/R. Degraeve/ G. Groeseneken/M. Heyns/H.E. Maes, IMEC Ltd. 2A.4Improvement of Gate Dielectric Reliability for p + Poly MOS Devices Using A Remote PECVD Top Nitride Deposition on Thin Gate Oxides—Y. Wu/G. Lucovsky, North Carolina State University

2A.5 Trap Assisted Tunneling as a Mechanism of Degradaton and Noise in 2-5nm Oxides—G.B. Alers/B.E. Weir/M.A. Alam/G.L. Timp/ T. Sorch, Lucent Technologies

2A.6 A New Algorithm for Transforming Exponential Current Ramp Breakdown Distributions into Constant Current TDDB Space—N.A. Dumin, Texas Instruments

2A.7The Correlation of Highly Accelerated Q bd Tests to TDDB Life Tests for Ultra-Thin Gate Oxides—Y. Chen, University of Maryland/ J.S. Suehle, NIST/Y. Chen/B. Shen/J.B. Bernstein, University of Maryland/P. Chaparala/C.R. Messick, National Semiconductor

Tuesday March 31, 2:00 p.m. — Parallel Session B

Compound Semiconductor/ optoelectronics

2B.1Early Variations of the Base Current in In/C-DOPED GaInP/GaAs HBT's—M. Borgarino, Universita' di Parma/R. Plana, CNRS/S. Delage/H. Blanck, Thomson LCR/F. Fantini, Universita' di Parma/ J. Graffeuil, CNRS

2B.2Degradation of InGaAs/InP Heterojunction Bipolar Transistors Under High Energy Electron Irradiation—A. Bandyopadhyay/ S. Subramanian, Oregon State University/S. Chandrasekhar, Lucent Technologies/S.M. Goodnick, Arizona State University

2B.3Reliability of Silicon Germanium (Si/SiGe) Heterojunction Bipolar Transistors—G.R. Hueckel/D. Ahlgren, IBM Corporation

2B.4Dislocation Dynamics in Heterojunction Bipolar Transistor Under Current Induced Thermal Stress—C.-T. Tsai, L.L. Liou, Wright Laboratory

2B.5A Novel, High Resolution Non-Contact Channel Temperature Measurement Technique—Q. Kim/S.A. Kayali, Jet Propulsion Laboratory

2B.6REDR-Based Kinetics for Line Defects Leading to Sudden Failures in 980 nm SL SQW InGaAs Laser Diodes—A. Bonfiglio/M.B.Casu /M. Vanzi, University of Cagliari, F.Magistrali/M.Maini/G. Salmini, Pirelli Cavi

2B.7A Novel Reliability Projection Model of Semiconductor Laser Diodes by Correlating Thermal Characteristics with Long-Term Degradation—N. Hwang/J.-T. Moon/M.-K. Song,/K.-E. Pyun, ETRI

2B.8Degradation of Single-Quantum Well InGaN Light Emitting Diodes Under High Electrical Stress—D.L. Barton, Sandia National Laboratories/M. Osinski/P. Perlin/P.G. Eliseev/J. Lee, University of New Mexico

Wednesday April 1, 8:15 a.m. —Parallel Session A

Failure Analysis

3A.1 (Invited) A Reliability Study of Titanium Silicide Lines Using Micro-Raman Spectroscopy and Emission Microscopy—I. DeWolf/ D.J. Howard/M. Rasras/A. Lauwers/K. Maex/G. Groesenken, and H.E. Maes, IMEC

3A.2 Backside Localization of Open and Shorted IC Interconnections—E.I. Cole Jr. /P. Tangyunyong/D.L. Barton, Sandia National Laboratories

3A.3 Dynamics of Backside Wafer Level Microprobing—D.T. Hurley, Hypervision

3A.4 A New Failure Mechanism by Corrosion of Tungsten in a Tungsten Plug Process—S. Bothra/H. Sur/V. Liang, VLSI Technol- ogy

3A.5 Cross-sectional Atomic Force Microscopy of Focused Ion Beam Milled Device—J.L. Ebel/C. Bozada, Wright Laboratory/T.E. Schlesinger, Carnegie Mellon University/C. Cerny/G. DeSalvo/ R. Dettmer/J. Gillespie/T. Jenkins/ K. Nakano/C. Pettiford/T. Quach,/ J. Sewell,/G. Via,/R. Welch, Wright Laboratory

3A.6 Nanoscale Electrical Characterization of Thin Oxides with Conducting Atomic Force Microscopy—A. Olbrich/B. Ebersberger/ C. Boit, Siemens AG

3A.7 High-Resolution Current and Temperature Mapping of Electronic Devices Using Scanning Joule Expansion Microscopy—J. Varesi/ M. Igeta/S. Muenster/A. Majumdar, University of California, Berkeley

Wednesday April 1, 8:15 a.m. — Parallel Session B

Hot Carriers

3B.1 Key Issues in Assessing Circuit-Level Hot-Carrier Reliability—W. Jiang/J.E. Chung, MIT/T.E. Ko-

pley/W. Li/P.J. Marcoux, Hewlett-Packard Company/C. Dai, Intel Corporation

3B.2 Effects of Advanced Processes on Hot Carrier Reliability—S. Aur/ T. Grider/V. McNeil/T. Holloway/R. Eklund, Texas Instruments

3B.3 Hot-Carrier Degradation Mechanism and Promising Device Design of nMOSFETs with Nitride Sidewall Spacer—U. Sambonsugi/ T. Sugii, Fujitsu Laboratories Ltd.

3B.4 Effects of Halo Implant on Hot Carrier Reliability of Sub-Quarter Micron MOSFETs—A. Das/H. De/V. Misra/S. Venkatesan/ S. Veeraraghavan/M. Foisy, Motorola

3B.5 Channel Coupling Imposed Tradeoffs Between Hot-Carrier Degradation and Single Transistor Latch-up in FD SOI MOSFET' s—F.L. Duan/D.E. Ioannou, George Mason University/ H.L. Hughes, Naval Research Laboratory/S.T. Liu, Honeywell SSEC

3B.6 Comparison of Hot-Carrier Effects in Deep Submicron N- and P-channel Partially- and Fully-depleted Unibond and SIMOX MOSFETs—S.H. Renn, LPCS/ENSERG/C. Raynaud/J.L. Pelloie, LETI-CEA (DMEL/CENG)/F. Balestra, LPCS/ENSERG

3B.7 Voltage Scaling and Temperature Effects on Drain Leakage Current Degradation in a Hot Carrier Stressed n-MOSFET—T. Wang/ C.F: Hsu/L.P. Chiang/N.K. Zous/C.Y. Chang, National Chiao-Tung University/T.S. Chao, National Nano Devices Lab.

Wednesday April 1, 2:00 p.m. —Parallel Session A

Packaging & Assembly

4A.1 Method for Equivalent Acceleration of JEDEC/IPC Moisture Sensitiv- ity Levels—R.L. Shook/B.T. Vaccaro, Lucent Technologies

4A.2 Critical Parameters for Reliable Surface Mounting of High Pin-count Packages—B.L. Euzent/B. Kawanami/S.Lau, Altera Corporation

4A.3 Elimination of Bond-pad Damage Through Structural Reinforcement of Intermetal Dielectrics—M. Saran/R. Cox/C. Martin/G. Ryan/ T. Kudoh/M. Kanasugi/J. Hortaleza,/M. Ibnabdeljalil/M. Murtuza, Texas Instruments

4A.4 The Evolution of Hydrogen from Plastic Molding Compound and It's Effect on the Yield and Reliability of Ferroelectric Memories— E.M. Philofsky, Ramtron International/C.R. Ostrander/S.J. Hartman, Trace Analytical, Inc. 4A.5 In-Situ Monitoring of Bond Degradation in Power IC' s Under High Current Stress—B. Krabbenborg, Philips Semiconductors

4A.6 Prediction of Thermal Resistance Degradation During Thermal Cycling—J. Naderman/F.W. Ragay/A. van Eck/J. van de Water, Philips Semiconductors

4A.7 Influences of Fan-in/Fan-out Structure and Underfill Fillet on TCT Reliability of Flip Chip BGA—H. Shimoe/T. Iijima/T. Iiyama/K. Oyama/H. Taguchi/Y. Hiruta, Toshiba Corporation

4A.8 CSP Solder Joint Reliability and Modeling—M. Amagai, Texas Instruments

Wednesday April 1, 2:00 p.m. — Parallel Session B

LATCHUP/ESD

4B.1 (Invited) Latchup in CMOS Technology—M. Hargrove/S. Voldman/ R. Gauthier/J. Brown/K. Duncan/W. Craig/H. Zappe/G. Hu, IBM

4B.2 A Study of ESD-Induced Latent Damage in CMOS Integrated Circuits—Y. Huh/M.G. Lee*/J.S. Lee/H.C. Jung*/T. Li/D.H. Song*/ Y.J. Lee*/J.M. Hwang*/Y.K. Sung**/S.M. Kang, University of Illinois, Urbana-Champaign *LG Semicon Co., Ltd. **Korea University

4B.3 High Current Effects in Silicide Films for Sub-0.25 µm VLSI Technologies—K. Banerjee/A. Amerasekera/J.A. Kittl, Texas Instruments/ C. Hu, University of California, Berkeley

4B.4 High-Current Transmission-Line Pulse Characterization of Aluminum and Copper Interconnects for Advanced CMOS Semiconductor Technologies—S.H. Voldman/ R. Gauthier/ D. Reinhart/K. Morrisseau, IBM Microelectronics

Process Induced Damage

4B.5 Antenna Protection Strategy for Ultra-Thin Gate MOSFETs—S. Krishnan/A. Amerasekera, Texas Instruments

4B.6 Reduction of Plasma-Induced Gate Oxide Damage Using Low-Energy Large-Mass Ion Bombardment in Gate-Metal Sputtering Deposition—T. Ushiki/M.C. Yu/K. Kawai/T. Shinohara/K. Ino/ M. Morita/T. Ohmi, Tohoku University

4B.7 Characterization of Plasma Charging Damage in Ultrathin Gate Oxides—H.-C. Lin/C.-C., Chen*/M.-F. Wang*/S.-K. Hsien**/ C.-H. Chien*/T.-Y. Huang/C.-Y. Chang*/T.-S. Chao, National Nano Device Laboratories *National Chiao-Tung University **National Tsing-Hua University

Thursday April 2, 8:15 a.m. — Plenary Session

Interconnect & Metallization

5.1 Stress-Induced Voiding Failure in Stacked Tungsten Via Structure—S. Domae/H. Masuda/K. Tateiwa/Y. Kato/ M. Fujimoto, Matsushita Electronics Corporation

5.2 Statistics of Microstructure for Via Metallization and Implication on Electromigration Reliability —H. Toyoda/ P.-H. Wang/P.S. Ho, University of Texas, Austin/M. Gall/H. Kawasaki, Motorola

5.3 Ti Layer Thickness Dependence on

Electromigration Performance of Ti/AlCu Metallization—M. Hosake/T. Kouno/ Y. Hayakawa/H. Niwa/M. Yamada, Fujitsu Ltd.

5.4 Effect of H 2 O Partial Pressure and Temperature During Ti Sputtering on Texture and Electromigration in AlSiCu/Ti/ TiN/Ti Metallization—T. Yoshida/S. Hashimoto/Y. Mitsushima/T. Ohwaki/Y. Taga, Toyota R&D Labs., Inc.

5.5 Cu Damascene Interconnects with Crystallographic Texture Control and Electromigration Performance—K. Abe/ Y. Harada/H. Onoda, Oki Electric Industry Co., Ltd.

5.6 Effect of VLSI Interconnect Layout on Electromigration Performance—E.M. Atakov/T.S. Sriram/D. Dunnell/ S. Pizzanello, Digital Equipment Corporation

5.7 Full-Chip Reliability Analysis—S. Rochel/G. Steele, Simplex Solutions, Inc./J. Lloyd, Lloyd Technology Associates, Inc./D. Overhauser, Simplex Solutions, Inc.

Thursday April 2, 2:00 p.m. — Plenary Session

Device & Process

6.1 A Comparative Study of Leakage Mechanism of Co and Ni Salicide Processes—K. Goto/J. Watanabe/ T. Sukegawa*/A. Fushida*/M. Sakuma*/T. Sugii, Fujitsu Laboratories Ltd. *Fujitsu Ltd.

6.2 Impact of Screening of Latent Defects at Electrical Test on the Yield-Reliability Relation and Application to Burn- In Elimination—J.A. van der Pol/E. Ooms/A. van ‘t Hof/F. Kuper, Philips Semiconductors

6.3 Extended Data Retention Process Technology for Highly Reliable Multi-Level FLASH EEPROMs of More than 10 6 W/E Cycles—F. Arai/T. Maruyama/R. Shirota, Toshiba Corporation.

6.4 Hot-Electron Degradation and Unclamped Inductive Switching in Sub-micron 60V Lateral DMOS—M.S. Shekar/ M. Cornell/M.-Y. Lio/M. Darwish/R.K. Williams, Siliconix Inc.