Reliability Society

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

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IEEE

C O N T E N T S

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

President's Message

IEEE and Industry

IEEE Headquarters is in the process of beginning a study to determine how IEEE may relate better to industry. Although IEEE produces a vast amount of technical information and has the extensive IEEE Advantage benefits program, there has been a recent perception that the IEEE is moving away from its industrial base. The forthcoming study will address both that perception and the facts that may have created it.

One of the reasons that the above described perception might have arisen is the decreasing availability of time for industrial IEEE members to participate in activities other than those related very directly to product generation. One hears about the increase in the average work week and the reluctance of industrial management to participate in activities that might be viewed as overhead. Even government employees find themselves subjected to increasing limitations on participating in these types of activities. Members from academic institutions and private individuals seem to have an easier time in participating.

It is easy to understand the industrial viewpoint in terms of the need for a "quid pro quo." If an industrial member spends the time to participate in IEEE activities, what do both the company and the employee get in return. The Reliability Society understands this viewpoint and is moving to provide more direct returns to its members. In my last column, I reported on how the Reliability Society reorganized its technical committees to help focus on emerging technologies. That reorganization only set up an administrative framework for getting more useful information to the society members.

Now, the Society has taken another step by including technical briefs on emerging technologies in its newsletters. The Newsletter technical briefs are intended to provide readers with a short introduction to the reliability aspects of emerging technologies. These briefs are intended to "dovetail" with major technology themes in IEEE publications such as Proceedings and Spectrum. The briefs should appeal to a wide range of readers: industrial members will benefit from the "heads-up" about technology reliability; academic members will find the briefs to be stimuli for new reliability research. The briefs will supplement our video tutorials and technical

continued on page 40

Editor's Column

Please support Loretta, our candidate, when voting.

The Division VI N&A Committee composed of the 5 Society Presidents met in New Orleans and decided unanimously to nominate four (4) candidates for the position of Division VI Director/Delegate

The candidates are:

Loretta Arellano,
Reliability Society

Kenneth Foster,
Society on Social Implications of Technology

Gerald Gaynor,
Engineering Management

Mark Hasselkorn,
Professional Communications Society

Thanks

Dave Franklin

Editor

Reliability Society Newsletter Inputs

All RS newsletter inputs should be sent to:

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The schedule for submittals is:

Newsletter	Due Date
January	October 8
April	January 8
July	April 8
October	July 8

ADVERTISING RATES

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.

Ad Size	One Time	2-3	4+
Full Page	$400	375	350
Half Page	$300	280	260
Third Page (vertical)	$240	225	210
Quarter Page	$205	190	180
Eighth Page	$120	110	100

Discounted per issue rates are shown for ads run in more than one issue.

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Cincinnati Chapter

A joint meeting with the American Society of Civil Engineers (ASCE), the Ohio Society of Professional Engineers, and the Northern Kentucky Chapter of the Kentucky Society of Professional Engineers (NKSPE) February 24, 2000. In addition, many other technical and professional societies were represented by those in attendance.

This year's award winners were as follows:

Distinguished Engineer (a.k.a. Herman Schneider Award): Carl F. Evert, Jr., PE, Ph.D. (nominated by the Retired Engineers and Scientists of Cincinnati)

Distinguished Scientist: Bobby L. Barnett, Ph.D. (nominated by the Cincinnati Chapter of the American Chemical Society)

Young Engineer of the Year: Bret Edward Norton, PE (nominated by the Ohio SW District of the American Water Works Association)

Professional Accomplishment in Consulting: George J. Thelen, PE (nominated by the No. KY Chapter of Kentucky Society of Professional Engineers)

RESC Lifetime Achievement Award: Phillip D. Spiess (nominated by the Retired Engineers and Scientists of Cincinnati)

CHAIR'S MESSAGE

by Ron Harbaugh, Section Chair

Our thanks to Don Sivitz and Larry Van Tuyl from Full Service Networking for their presentation of the features and functions of Windows 2000 Professional, Windows 2000 Server, and Windows 2000 Advanced Server at the Hartwell Recreation Center on January 20, 2000. Everyone enjoyed the program. Full Service Networking specializes in the design, installation and support of computer networks. Take a look at their Web Page. We are discussing a variety of arrangements with a representative from Kings Island for the proposed IEEE spring family outing. We have a tentative date of June 3, 2000. Check your newsletters for information on each meeting.

The Man Who Invented the Web

by Dick Reiman, Historian

Tim Berners-Lee, 41, creator of the World Wide Web, wasn't good at connections such as names and faces, and in 1980, wrote some software as a memory substitute. His method of finding things has grown into the World Wide Web which some place as important as the invention of the printing press. Such an important development has not brought him wealth and fame; some of this has gone to Marc Andreesen, co-founder of Netscape who has been on the cover of magazines. Berners-Lee drives an old Volkswagen

Rabbit, not a Mercedes-Benz like Marc. His non-profit group, World Wide Web Consortium at MIT, which helps set technical standards for the Web is a modest organization.

His energy level is like Robin Williams'; he is British and an Oxford physics major. His relentless enthusiasm has guided the Web to success. He is not altogether happy on the nature of the Web, in fact gives it a B-plus as a force for good. Why isn't he rich? Answer: Tim's not after money.

His parents are part of his success. They helped design the Ferranti Mark 1, the world's first commercially computer. Growing up, he read Arthur C. Clarke's science fiction story "Dial F for Frankenstein" which contemplated crossing the threshold of enough computer power to be an autonomous thinking machine, ala Hal in 2001, also a Clarke creation. Is the World Wide Web (WWW) a thinking machine, a global brain? No and yes. Will it transform society? For the better? Stay tuned.

Burners-Lee is dedicated to making the emerging properties of WWW both benign and with a minimal degree of order. As director of the Web, he brings together its members, Microsoft, Netscape, Sun, Apple, IBM, and 155 others, and tries to obtain consensus on technical standards in the evolving software market. Can the Web stay as one and only, or will it break down so that you will need 16 browsers to find things?

The test is to keep widely respected standard HTML 3.2 which eases travel on the Web universal. Proposed also is PICS, Platform for Internet Content Selection, to let parents filter out offending Websites. None have the effect of law, and compliance is voluntary.

The right time was 1980, and the right place was CERN, a European physics laboratory on the Swiss-French border, for Berners-Lee to create his personal memory substitute for finding information at CERN. He called it "Enquire". It allowed him to fill a document with words, which would lead him to another document for answers. This idea had earlier been proposed by Vannevar Bush in 1945 and is called "hypertext", an interlocking of documents performed by a single click.

In the late 1980's, documents could be deleted including the "dangling links", the signposts or arrows that kept tracks of the links to the next document. If these dangling links could be retained even though the document was deleted, the systems could be made worldwide. Messy, but essential. Berners-Lee wrote a proposal to link CERN's resources by hypertext, whether they be text, graphic, video, anything, a "hypermedia system", and eventually a system that could go global. Berners-Lee persisted at CERN and a NeXT computer at his desk became the first Web content "server".

The Sixth Interamerican Conference on Engineering and Technology Education (INTERTECH 2000) will be held in Cincinnati, Ohio USA from June 14–June 16, 2000. The conference will be hosted by the University of Cincinnati. The Theme of the conference: "Engineering Education in the Americas and the New Millennium".

INTERTECH offers a unique opportunity for the discussion of issues related to the needs and interests of Engineering and Technology Education in the Americas as well as the development of links with colleagues from the Americas and around the world.. It also provides, in many diverse technical and plenary sessions, a major forum for the exchange of information on research and development in all fields of Engineering.

The conference generates countless opportunities for technological and educational interchanges, fostering the implementation of projects related to student and faculty exchanges, joint research and technological training throughout the Americas.

INTERTECH 2000 will mark the 10th anniversary in the evolution of this organization.

For more information including registration forms, please visit the conference web site at: *http://intertech2000.uc.edu*

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Twin Cities Minnesota Chapter

The November 16, 1999 meeting covered the "Impact of Safety Regulations to product reliability in the International Market". The speaker, Mike Sherman of FSI, gave examples of how the regulations tie to reliability during the design process. Fifteen people attended this meeting.

The January 18 meeting was to be a presentation by James Steel of Medtronic, Microrel division of Phoenix. The topic was "Microcircuit Control and Development Protocol". This talk was to cover biomedical applications and other important markets for microcircuits.

The February 15 meeting was scheduled to be " Reliability Predictions, Fact or Fiction" by James McLinn, CRE of Hanover, Minnesota. The meeting covered the history of the prediction, as well as, the value of prediction for design improvement.

The March 21 meeting is on Markov Models for Reliability Assessment". The speaker, Paul Pukite of United Defense will cover the application of these diagrams to the easy analysis of Fault Trees, Maintainability and Cut Sets.

The April 18 meeting, a talk on "Design of Experiments" by Mark Anderson of Stat-Ease Corp.

The May 16 meeting will be a plant visit to Twin City Test to review test methods and equipment for Accelerated Life Testing.

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Report on 1999 Activities - IEEE Singapore, REL/CPMT/ED Chapter

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Report by: YC Ng,
Secretary of Singapore
REL/CPMT/ED Chapter.

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Mauro Ciappa
Switzerland Chapter Chair
email:

Reliability Society AdCom Meeting

1/22/2000 LAX Marriott

Attendees Way Kuo, Val Monsha, Bob Loomis, Tom Fagan, Dick Kowalski, Ann Campbell, Patrick Hetherington, Bill Tonti, Joanne Dugan, Lori Kaufman, Dick Doyle, Loretta Arellano, Dennis Hoffman, Ken LaSala, Jeffrey Voas, Bob Gauger, Victor Wouk, Phil Tsung, Bud Trapp, Koichi Inoue, Takehisa Kohda, Sam Keene, Alan Street.

The meeting was called to order by Ken La Sala at 9am. The agenda and minutes of the previous meeting were approved. AdCom authorize Ken La Sala to buy Acrobat Exchange software. This will be an asset/property of the Reliability Society. Jeff Voas will get the AdCom roster back into a Microsoft Word (.doc) format and send to Dennis Hoffman and Loretta.

Dick Kowalski will find out what organization/IEEE Society TSM reports to and what percentage ownership the RS has in it.

AdCom approved to continue sending IRPS Proceedings, TSM, TR, RAMS Proceedings, and the Newsletter to all RS members, and to keep $25 as the fee for RS membership in 2001, and to keep the non-member fee at $200 for 2001.

The following travel reimbursement scheme was approved: AdCom members (1st meeting that an AdCom member attends can get up to - $500, 2nd meeting that an AdCom member attends can get up to - $1000 cum., 3rd and 4th meeting that an AdCom member attends can get up to - $2000 cum.), and EXCOM (1st meeting that an EXCOM member attends can get up to - $800, 2nd meeting that an EXCOM member attends can get up to - $2000 cum., 3rd meeting that an EXCOM member attends can get up to - $4000 cum., 4th meeting that an EXCOM member attends can get up to - $5000 cum.). This change was made effective for the January 2000 meeting.

The summer 2000 AdCom meeting and tutorials will be held in Burlington Vermont. Jeff Voas will bring back a recommendation at the next AdCom as to which conferences we tie AdCom meetings to.

It was decided to only send the CDROM format of the IRPS 2000 Proceedings to RS members. 100 number hard copies of the Proceedings would be made available to people who want a printed copy. These will be issued on a first come first serve basis in response to written requests.

The RS will be a 50% sponsor of the *Trans. on Reliability of Electronic Materials and Devices*. EDS will be the other 50% sponsor. The RS will work with EDS to develop a management plan that is acceptable to both societies. It was suggested that a change to the title of the publication be considered.

Tech Ops reorganization was approved. (see page 2 for organization listing)

The travel reimbursement for TR Associate Editors of $500 effective immediately was approved.

The meeting was adjourned

IEEE RELIABILITY SOCIETY AdCom MEETING Agenda

08 April 2000

8:30 AM Call to Order - K. La Sala

8:30-8:45 Agenda Approval - K. LaSala

8:45-9:00 Minutes Approval - Jeff Voas

9:00-9:30 President's Report - K. LaSala
- TAB series report - K. LaSala
- Review of action items from last meeting - D. Hoffman

9:30-10:00 Treasurers Report - R. Kowalski
- Budget report
- FY001 Budget

10:00-10:15 Break

10:15-10:30 Meetings - J. Voas
- Conference closeouts
- RAMS report - J. Voas or RAMS representative
- IRPS and IRW reports - W. Tonti

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AdCom Agenda

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- ISRE report - S. Keene
- Proposed partnership in International Research's upcoming "Implementing Predictive Maintenance to Convert Reliablilty into Profitability" conference, being held in San Diego in June 2000. - J. Voas

10:30-11:00 Membership - P. Hetherington/M. Abramo
- Membership Report - focus on reversing 5-year trend - P. Hetherington/M. Abramo
- PACE - L. Arellano/M. Abramo
- Chapters - L. Arellano
- Millennium medals - L. Arellano

11:00-11:30 Publications - R. Loomis
- Transactions report - W. Kuo
- Newsletter report - D. Franklin
- Web site update - R. Loomis
- Video Program status - S. Keene
- T-REMD title conversion to T-DMR and management plan progress - R. Loomis

11:30-12:00 Junior Past President's Report - L. Arellano
- Nominations Committee Report
- Awards and Medals report
- Updated field of interest progress
- By-laws and constitution revision progress

12:00-1:00 Lunch

1:00-1:30 Technical Operations – K. Inoue
- Technical operations status and committee significant events
- Standards - T. Brogan/Y. Lord (excluding P.1413.1)
- Council and liaison news - Sensors, Superconductivity, Nanotechnology, Intelligent Transportation Systems – RS representatives

1:30-2:30 Special Presentation: P.1413.1, Reliability Prediction Guide - J. Elerath , P.1413.1 Working Group Representative

2:45-4:00 RS AdCom Executive Session - P.1413.1 Reliability Prediction Guide - AdCom

4:00-4:15 Senior Past President's Report
- Long-Range Planning - R. Doyle

4:15-4:30 Old business
- www based IEEE RS skill bank

4:30-5:00 New Business

5:00 Adjourn

Tech-Ops Technical Committees Reorganized

Technical Committees in Technical Operations have been reorganized effective on January 1, 2000. The need for reorganization, reorganization principles and results are summarized below (based on Tab Review documents prepared by Ken La Sala).

Need for Technical Committee reorganization:

- Perceived detachment from mainstream of technology evolution as documented in IEEE publications.
- Inadequate service to members in terms of useful "on-the-job" information - video tutorial program a step in the right direction.
- "Same old stuff" standards - emerging technologies unattended.
- Primarily academic Transactions (probably not unique to Reliability Society).
- Inactive committees.
- Organizational complexity 30 committees and liaisons.

- **Reorganization Principles:**
- Combine liaisons and technical committees so each technical committee has a liaison function, where appropriate.
- Combine committees with similar interests.
- Eliminate inactive committees.
- Restructure the committees into systems committees and technology committees.
- Reduce the number of Technical Operations entities.

Reorganization Results:

- Technical Operations entities have been reduced from 30 to 20.
- Inactive committees were eliminated
- Committees with common interests have been combined
- Liaison responsibilities were incorporated into committees, giving committees greater basis for existence
- Reliability Society relevance to technology evolution is improved

To introduce the reorganized and new Technical Committees to the readers, I invited every Chairperson to write a brief introduction of their committee. The followings are the results, which is slightly compiled and edited by myself. You will notice that almost every chairperson invites you to take part in the activities. If you are interested in the activity of a specific Technical Committee, I would suggest not hesitating to contact the Chairperson.

Koichi Inoue
VP TechOps
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Technology Committees (12 Committees):

- **CAD/CAE**
  Chair: D. R. Hoffman (Dhoffman44@aol.com)
  Information not available.

- **Human Interface Technology** (formally Human Performance Technology)
Chair: Kenneth LaSala (NOAA, k.lasala@ieee.org)
Members: Jay Crowley (Food and Drug Administration), Lucia Vilela Leite Filgueiras (University of Sao Paulo), Helen M. Gigley (Office of Naval research), William R. Nelson (Lockheed Martin Idaho Technologies Co.), Richard S. Ullman (ITT Defense & Electronics), Yi Hong (Shanghai Jiao Tong University), Ned Criscimagna (Reliability Analysis Center, IITRI), Takehisa Kohda (Kyoto University), Roger Grice (Rensselaer Polytechnic Institute)

The Scope, Objectives and Activity Plans:

The Human Performance Reliability Committee has the principal objective of increasing the sensitivity of system designers and program managers to the important impact of humans on system reliability. The Committee achieves this objective through the following activities: standards and guidance document development, presentations and tutorials, and publications in a variety of journals and magazines. The Committee members represent a broad range of scientific expertise, engineering expertise, and program management. This mix of perspectives ensures Committee products are applicable to many types of customers. The most recent Committee product is the IEEE videotape tutorial entitled Designing Systems for Reliable Human Performance.

The Expected Results from Activities:

- Web tutorials and guides,
- IEEE Human Performance Reliability standard.
- CD Tutorial - conversion from videotape.
- RAMS Tutorial - update of 1995 tutorial
- Newsletter Articles (1-2 pages) - at least two per year
- Newsletter Announcements - as appropriate
- Answer member questions - continual; e-mail queries preferred
- Transactions article - possibly a tutorial article by committee; possibly individual articles
- Volunteers will be accepted.

- **International Reliability**
Chair: J. P. Rooney (jprooney@foxboro.com)
Information not available.

- **Mechanical Reliability**
Co-Chair: R. L. Doyle (Doyle and Associates, r.doyle@ieee.org)
Co-Chair: P. Hetherington (RAC, Griffiss AFB, Phetherington@IITRI.ORG)
Members: James D. Raze (Belvoir R&D Center), Douglas Holzhauer (RADC/RBES, Griffiss AFB), Chuck Hamstra (NWSC), Ken Blemel, Bruce Blackford (Research Analysis Corp), David Weis (University of MD), Mike Pecht (University of MD), N. Bernstein (Israel Aircraft Industries)

The Scope, Objectives and Activity Plans:

Publish a summary of our activities in the newsletter. Establish a procedure for holding an annual meeting of all committee members to discuss: 1.) Strengths and weaknesses of our committee, 2.) How they can improve their input to us by reporting what they are doing, 3.) Establishing better communications and more interaction between committee members (Email). Send out a letter to committee members requesting that they become more active in our Committee.

The Expected Results from Activities:

- Tutorial (Video)
- Tutorials (RAMS & IRPS)
- Newsletter Articles (1 every 6 months)
- Newsletter Announcements (1 per year)
- Corresponding Members will be Accepted.

- **Microelectronic Technologies**
Co-Chair: A. N. Campbell (Sandia National Labs., ancampbe@sandia.gov)
Co-Chair: T. A. Rost (Texas Instruments, t-rost@ti.com)
Members: M. A. Abramo (IBM Microelectronics), M. Ciappa (Swiss Federal Institute of Technology), A. G. Street (Integrated Reliability), W. R. Tonti (IBM Microelectronics), O. D. Trapp (Technology Associates)

The Scope, Objectives and Activity Plans:

The interest of the Microelectronic Technologies Committee is the reliability of microelectonic devices and microsystems (including sensors, MEMS, and Optoelectronics). Our objective is to serve our membership by informing them of developments and activities in these fields, and we will primarily communicate this through the Reliability Society Newsletter. In addition, we will support Society projects including the video programs and Tutorials. We welcome your input regarding specific topics of interest to you (please send your inputs to Ann Campbell, ancampbe@sandia.gov).

The Expected Results from Activities:

The primary output of the committee activities will be articles in the Newsletter. In addition, we expect the development of video tutorial topics and possibly articles in the Transactions.

Volunteers wil be accepted.

- **Reliability Design**
Chair: M. Roush (UMD, roush@eng.umd.edu)
Information not available.

- **Reliability Methodology**
Chair: C. K. Hansen (Eastern Washington Univ., c.k.hansen@ieee.org)
The Scope, Objectives and Activity Plans:

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Tech-Ops

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The primary objective of the Reliability Methodology (RM) committee is to gather and communicate, on a continuing basis, information about current trends and developments in reliability methodology, primarily those based on mathematical and statistical techniques. Specific areas dealt with include, but are not limited to:

- Failure data analysis and modeling (repairable as well as non-repairable units)
- Test-Analyze-and-Fix (TAAF) methods.
- Failure Mode, Effects and Criticality Analysis (FMECA).
- Neural network methods.
- Monte-Carlo simulation methods.
- Markov modeling methods.
- Fault tree analysis methods.
- Fuzzy Logic.
- Reliability Indicator Methods.
- Burn-in and screening methods.

Information on new methodologies will be gathered primarily based on papers presented at national and international reliability conferences and journals devoted to reliability topics, including but not limited to, the *Reliability and Maintainability Symposium* (RAMS), the *European Symposium on Reliability of Electron Devices, Failure Physics and Analysis* (ESREF), the *IEEE Transactions on Reliability, Quality and Reliability Engineering International*, and *Reliability Engi- neering and System Safety*.

The committee will participate in on-going efforts to create and revise new and existing standards on the use of reliability methodology, and participate in the debate of current and/or controversial issues by periodically submitting short articles to the Reliability Society Newsletter.

The committee will actively seek to expand its wide range of information sources in order to maintain a high level of objectivity. The members of the committee will continue to enhance their professional expertise by engaging into research and development projects, remain current with new published literature, and help communicate and promote the understanding of new reliability methods through active participation in conferences.

The Expected Results from Activities:

- Recruiting new members for the committee.
- Submission of one or two short articles to the RS Newsletter. It is anticipated that one article will be submitted by the chair, and at least one will be submitted by other committee members.
- The chair of the committee will serve as editor of the annual report on the *Status of Reliability Engineering Technology*. The report will cover all aspects of Reliability Engineering Technology as covered by the Reliability Society Technical Committees. The completion of this report, thus, is contingent upon receiving sufficient input from the other RS Technical committee chairs. Input will also be solicited from the Reliability Society Officers, from members of the Reliability Society and other professionals in the reliability field willing to contribute. Information found on the Internet will be used if considered credible. Input from the committees should be collected no later than August 1, 2000. The VP of Technical Operations will be responsible for requesting input for the committee chairs, and sending out reminders as necessary to meet this deadline. A draft version of the report will be circulated during the fall of 2000 and its final version should be published in the January 2001 issue of the Reliability Society Newsletter.
- d) Participation in reviewing and revising new and existing standards in the area of reliability methodology through the participation in IEC WG2 International working group and the ASQ National Z1 committee on dependability.
- Participation in the annual Technical Operations Meetings and quarterly AdCom meetings. As minimum the chair will participate in the Technical Operations Meeting (subject to available travel funds) and the AdCom meeting held the same week-end.
- Participation in the Annual Reliability and Maintainability Symposium (RAMS). This conference is considered the key national conference related to reliability methodology, and all members of the committee are encouraged to participate in this event through one or more of the following: presenting a research paper or tutorial, participating on a panel, organizing/moderating paper sessions.
- Give presentations on general or specific reliability topics on (other) appropriate occasions. Members of the committee are encouraged to submit their names for the RS Speaker's list.
- Participation in research and development projects related to reliability methodology as appropriate within the boundaries of the individual committee members' job description.

New members will be accepted provided that they are active in the reliability field, and they are able and willing to contribute to the activities planned for the committee.

■ **System Safety**

Chair: Y. Sato (Tokyo Univ. of Mercantile Marine, yoshi@ipc.tosho-u.ac.jp)

Members: T. Inagaki (Univ. of Tsukuba), T. Koda (Kyoto Univ.), K. Suyama (Tokyo University of Mercantile Marine), K. Inoue (Kyoto University).

The Scope, Objectives and Activity Plans:

The scope and objectives of the committee are to survey and develop system safety technologies and to apply those to safety problems. In 2000, we are to start analyzing and assessing safety of adaptive cruise-control systems for automobiles.

The Expected Results from Activities:

Standards/guides, transactions papers, newsletter articles, and answering questions from members.

Volunteers will be accepted.

- **Software Reliability**

Chair: S. J. Keene, Jr. (s.keene@ieee.org)
Members: Bill Everett (SPRE), Allen Nikora (JPL), Ram Chillerege (IBM), Jeffrey Voas (RST), Joanne Dugan (UVA), Craig Hyde (RSC), Carol Smidts (UMD), Norm Schneidewind (Naval Postgraduate School), John Munson (Cylant Technology)

The Scope, Objectives and Activity Plans:

Develop new initiatives whereby the Reliability Society can take a greater role in advancing software reliability and safety.

The Expected Results from Activities:

Tutorials (Video, Web, CD, RAMS, IRPS), Standards and Guides, Transactions Papers, Newsletter Articles (1-2 pages). Newsletter Announcements, Liaison Projects (Councils, Committees), and a point of contact for answering member questions, etc.

Any interested parties are invited to contact Sam Keene regarding their participation.

- **Standards & Definitions**

Co-Chair: Y. Lord (Northrop Grumman Co, Yvonne_Lord@ mail.northgrum.com)
Co-Chair: T. Brogan (Raytheon Command, Control, Communication and Information, Thomas_L_Brogan@ res.raytheon.com)

The Scope, Objectives and Activity Plans:

The function of this committee is to recommend (to the IEEE Standards Board) standards for Engineering practices, including definitions and Terminology, related to the field of Reliability Engineering. In addition, the committee will work with individual standards working groups to assist them in the proper utilization of Society and IEEE Standards Association guidelines and forms.

- Develop a set of operating procedures for Reliability Society standards generation
- Update and align the existing Reliability Society Standards Process with the latest IEEE Standards Association requirements
- Work with the P1467 working group in the finalization of their document, “Recommended Practice for Planning and Monitoring Product Reliability Growth in an Integrated Development Program”
- Monitor progress of the P1413 working group’s proposal to the IEEE – SA Standards Board to form an interim Standards Coordinating Committee (SCC)

Expected Results from Activities:

- Standards
- Updated Process Flow for Standards Process within Reliability Society Operating Procedures and Guidelines for Standards Development within the Reliability Society.
- Volunteers will be accepted.

- **Testing & Screening**

Chair: H. A. Chan (h.a.chan@ieee.org)
Information not available.

- **Warranty**

Chair: W. A. Zeller (Raytheon Systems Co., wazeller@west.raytheon.com)
Members: M. P. Kaminskiy (Qualcom, Inc.)

The Scope, Objectives and Activity Plans:

- Keep abreast of Warranty technology
- Develop best practices
- Develop warranty processes
- Generate videos
- Generate standards and guides
- Generate Newsletter Articles
- Perform liaison projects
- Maintain warranty part of IEEE Web site.

The Expected Results from Activities:

- Availability of state of the art Warranty technology
- Warranty best practice
- Written Best Practices
- Videos
- Standards and guides
- Newsletter Articles
- Liaison projects
- Page on IEEE web site
- Volunteers will be accepted.

Systems Committees (8 Committees)

- **Aero Space & Defense Systems**

Chair: Vacant

- **Consumer Electronics**

Chair: Vacant

- **Energy Systems**

Co-Chair: M. Lively (MbeLively@aol.com)
Co-Chair: J. Zamanali (jzamanali@lucent.com)
Information not available.

- **Industrial Systems**

Chair: Vacant

- **Information Technology & Communications**

Chair: H. Wolf (IRMAssociates and George Mason Univ., hwolf@gmu.edu)

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Tech-Ops

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The Scope, Objectives and Activity Plans:

The primary activity is addressing proposed laws and regulations at the state and federal level associated with regulating the Internet, such as privacy, intellectual property, band width, access, the digital divide (between rich and poor)., etc. The CCIP generates white papers advocating specific positions that IEEE should take about the technology or related issues.

The Expected Results from Activities:

Articles for Reliability Newsletter, Answer member questions, Support generation of IEEE USA position papers related to Congressional actions, Participate in workshops, meetings and IEEE actions.

- **Medical Systems**
  Chair: Vacant
- **Sensors**
  Chair: Vacant
- **Transportation Systems**
  Chair: Vacant

IEEE-SA News

To assist you in keeping abreast of IEEE Standards Activities, we have compiled a list of new, revised, and withdrawn standards projects, listed by sponsoring IEEE Society, that have been recently approved by the IEEE-SA Standards Board.

If you have any questions concerning the list below, please contact Jodi Haasz at j.haasz@ieee.org or +1 732 562 6367.

Sincerely,
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IEEE-SA Membership Marketing Administrator
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IEEE STANDARDS PROJECTS BY SOCIETY

AEROSPACE & ELECTRONIC SYSTEMS

GYRO ACCELEROMETER PANEL
New IEEE Standards Projects

P1559 Standard for Inertial Systems Terminology

Withdrawn IEEE Standards Projects

P1431 Standard Specifications Format Guide and Test Procedure for Coriolis Vibratory Gyros

RADAR SYSTEMS PANEL
Revised IEEE Standards

P521 Standard Letter Designations for Radar-Frequency Bands

ANTENNAS AND PROPAGATION PROPAGATION
Revised IEEE Standards Projects

P356 Guide for Measurements of Electromagnetic Properties of Earth Media

COMMUNICATIONS
New IEEE Standards Projects

P1520.2 Standard for Application Programming Interfaces for ATM Networks: Service/Signaling Control and Switch Control and Programming Interfaces

P1520.3 Standard for Application Programming Interfaces for Internet Protocol Network Elements

TRANSMISSION ACCESS & OPTICAL SYSTEMS
Revised IEEE Standards

P269 Standard Methods for Measuring Transmission Performance of Analog and Digital Telephone Sets, Handsets and Headsets

COMPUTER SOCIETY

BUS ARCHITECTURE
Withdrawn IEEE Standards Projects

P896 Standard for Futurebus+ - Logical and Physical Layers

P1275a Supplement to IEEE Std 1275-1994, IEEE Standard for Boot (Initialization Configuration) Firmware: Core Requirements and Practices Errata, Clarifications and Corrections

DESIGN AUTOMATION
Revised IEEE Standards Projects

P1076a Standard for VHDL Language Reference Manual (Amendment)

LEARNING TECHNOLOGY STANDARDS COMMITTEE
New IEEE Standards Projects

P1484.9 Standard for Information Technology Learning Technology - Localization

P1484.20 Standard for Information Technology Learning Technology Competency Definitions

LOCAL AND METROPOLITAN AREA NETWORKS
New IEEE Standards Projects

P802.3ae Standard for Information Technology Local & Metropolitan Area Networks Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Media Access Control Parameters, Physical Layers and Management Parameters for 10 Gb/s Operation

P802.3af Standard for Information Technology Telecommunications and Information Exchange Between Systems - Local & Metropolitan Area Networks Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)

P802.11b-1999/Cor 1-200x Corrigenda to IEEE 802.11b-1999, Information Technology Telecommunications and Information Exchange Between Systems Local and Metropolitan Networks Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Higher Speed Physical Layer (PHY) Extension in the 2.4 GHz Band

P802.15.2 Recommended Practice for Telecommunications and Information Exchange Between Systems LAN/MAN Specific requirements Part 15: Recommended Practice for Wireless Personal Area Networks Operating in Unlicensed Frequency Bands

Revised IEEE Standards Projects

P802.16.1 Standard for Telecommunications and Information Exchange Between Systems LAN/MAN Specific Requirements Air Interface for Fixed Broadband Wireless Access Systems

P1802.3 Standard for Conformance Test Methodology for IEEE Standards for Local and Metropolitan Area Networks Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

MICROPROCESSORS AND MICROCOMPUTERS
New IEEE Standards Projects

P1394.3 High Performance Serial Bus Peer to Peer Data Transfer Protocol

Revised IEEE Standards Projects

P1394a High Performance Serial Bus (Amendment)

Withdrawn IEEE Standards Projects

P1151 Standard for Modula II A Modular High Level Programming Language

P1596.7 Standard for a High-Speed Memory Interface (SyncLink)

PORTABLE APPLICATIONS
Withdrawn IEEE Standards Projects

P1003.1p Standard for Information Technology Portable Operating System Interface (POSIX) Part 1: System Application Program Interface (API) Amendment x: Resource Limit Interfaces [C Language]

SOFTWARE ENGINEERING
Revised IEEE Standards

P730 Standard for Software Quality Assurance Plans

STANDARDS COORDINATING COMMITTEE
Withdrawn IEEE Standards Projects

P1305 Recommended Practice for the Definition of Terms for Artificial Neural Networks

STORAGE SYSTEMS
New IEEE Standards Projects

P1563.1 Recommended Practice for Portable Tape Driver Architecture

P1563.2 Standard for Common Tape Driver Semantics

P1563.3 Standard for Common Format for Data on Tape

TEST TECHNOLOGY
Withdrawn IEEE Standards Projects

P1149.2 Standard for Shared Input/Output Scan Test Architecture

DIELECTRICS AND ELECTRICAL INSULATION SOCIETY STANDARDS COORDINATING COMMITTEE
Withdrawn IEEE Standards Projects

P97 Standard for Specifying Service Conditions in Electrical Standards

ELECTROMAGNETIC COMPATIBILITY
STANDARDS COMMITTEE
New IEEE Standards Projects

P1560 Standard for Methods of Measurement of Radio Frequency Interference Filter Suppression Capability in the Range of 100 Hz to 40 GHz

ENGINEERING IN MEDICINE AND BIOLOGY
Withdrawn IEEE Standards Projects

P1157 Standard for Healthcare Data Interchange Overview and Framework

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IEEE-USA Technology Policy Activities Appointments

Technology Policy Activities (TPA) committee appointments are IEEE-USA technology policy councils that issue IEEE-USA positions on technology issues. TPA committee appointments, for the year 2000 are:

- Committee on Communications & Information Policy: Mr. Hank Wolf
- Aerospace Policy Committee: Dr. Robert Loomis
- Medical Technology Policy Committee: (Vacant)
- Energy Policy Committee: Mr. Mark Lively
- Research & Development Policy Committee: Dr. Jeffrey Voas

Kenneth P. LaSala, Ph.D.
President
IEEE Reliability Society

IEEE-SA News
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MEDICAL INFORMATION BUS
Revised IEEE Standards

P1073.3.1 Standard for Medical Device Communications, Transport Profile Connection Mode

P1073.4.1 Standard for Medical Device Communications Physical Layer Interface Cable Connected

Withdrawn IEEE Standards Projects

P1073.1 Standard for Medical Device Communications Medical Device Data Language (MDDL) Overview and Framework

P1073.1.1 Standard for Medical Device Communications Medical Device Data Language (MDDL) Common Definitions

P1073.1.2 Standard for Medical Device Communications Medical Device Data Language (MDDL) Virtual Medical Device, Generalized

P1073.1.3 Standard for Medical Device Communications Medical Device Data Language (MDDL) Virtual Medical Device, Specialized

P1073.1.3.1 Standard for Medical Device Communications Medical Device Data Language (MDDL) Virtual Medical Device, Specialized Infusion Device

P1073.1.3.2 Standard for Medical Device Communications Medical Device Data Language (MDDL) Virtual Medical Device, Specialized Vital Signs Monitor

P1073.1.3.3 Standard for Medical Device Communications Medical Device Data Language (MDDL) Virtual Medical Device, Specialized Ventilator

P1073.2.2 Standard for Medical Device Communications Application Profile-Basic Capabilities

P1073.5 Standard for Medical Device Communications - Internetworking

FUEL CELLS, PHOTOVOLTAICS, DISPERSED GENERATION, AND ENERGY STORAGE (SCC21)

New IEEE Standards Projects

P1561 Guide for Sizing Hybrid Stand-Alone Energy Systems

P1562 Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) Systems

Withdrawn IEEE Standards Projects

P1373 Recommended Practice for Field Test Methods and Procedures for Grid-Connected Photovoltaic Systems

INDUSTRY APPLICATIONS

MARINE INDUSTRY
Revised IEEE Standards

P45 Recommended Practice for Electric Installations on Shipboard

PETROLEUM AND CHEMICAL INDUSTRY
New IEEE Standards Projects

P1566 Standard for Adjustable Frequency Drives Rated 500 HP and Larger

POWER SYSTEMS ENGINEERING
Revised IEEE Standards

P602 Recommended Practice for Electric Systems in Health Care Facilities

Withdrawn IEEE Standards Projects

P1429 Recommended Practice for Electrical Systems in Cleanrooms

INSTRUMENT AND MEASUREMENT

Withdrawn IEEE Standards Projects

P287 Standard for Precision Coaxial Connectors (DC-110 GHz)

INTELLIGENT TRANSPORTATION SYSTEMS (SCC32)

New IEEE Standards Projects

P1556 Standard for Security & Privacy of Vehicle/Roadside Communication including Smart Card Communication

MICROWAVE THEORY AND TECHNIQUES

Withdrawn IEEE Standards Projects

P1443 Standard for Microwave Network Parameters

NON-IONIZING RADIATION (SCC28)

New IEEE Standards Projects

PC95.1b Amendment to: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE C95.1-1991 (1999 ed)

NUCLEAR AND PLASMA SCIENCES

Withdrawn IEEE Standards Projects

P583a Supplement to Standard Modular Instrumentation and Digital Interface System (CAMAC)

POWER ENGINEERING

ELECTRIC MACHINERY
New IEEE Standards Projects

P1553 Standard for Voltage Endurance Testing of Form Wound Coils and Bars for Hydrogenerators

Withdrawn IEEE Standards Projects

P85 Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery

ENERGY DEVELOPMENT AND POWER GENERATION
Withdrawn IEEE Standards Projects

P1148 Cathodic Protection of Power Plant Equipment and Structures

P1251 Guide for Collection of Data on Personal Injuries in Generating Stations and Substations

P1437 Standard for the Integration of Plant Condition Monitoring Elements in Hydroelectric Facilities

INSULATED CONDUCTORS
New IEEE Standards Projects

P400.2 Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
P400.3 Partial Discharge Testing of Shielded Power cable System in a Field Environment
P1234 Guide for Fault Locating on Shielded Power Cable Systems

Revised IEEE Standards

P532 Guide for Selecting and Testing Jackets for Underground Cables
P635 Guide for Selection and Design of Aluminum Sheaths for Power Cables

Revised IEEE Standards Projects

P404 Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500-500 000V
P1508 Standard for Solder-Sweated Split Tinned Copper Connectors

NUCLEAR POWER ENGINEERING
Revised IEEE Standards

P308 Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations
P1023 Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities

Revised IEEE Standards Projects

P323 Qualifying Class 1E Equipment for Nuclear Power Generating Stations

POWER SYSTEM RELAYING
New IEEE Standards Projects

PC37.94 Standard for N times 64 kilobit per second Optical Fiber Interfaces Between Teleprotection and Multiplexer Equipment

Revised IEEE Standards Projects

PC37.105 Standard for Qualifying Class 1E Protective Relays and Auxiliaries for Nuclear Power Generating Stations
PC37.109 Guide for the Protection of Shunt Reactors

Withdrawn IEEE Standards Projects

P1331 Standard for Low Energy Analog Signal Inputs to Protective Relays

SUBSTATIONS
Revised IEEE Standards

P979 Guide for Substation Fire Protection

SURGE PROTECTIVE DEVICES
New IEEE Standards Projects

PC62.74 Guide for the Application of Surge Protective Devices for Equipment Connected to the 120/240V AC Power System and to Communication Circuits

SWITCHGEAR
New IEEE Standards Projects

PC37.13.1 Standard for Definite Purpose Switching Devices for Use in Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
PC37.74 Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV

Revised IEEE Standards

PC37.29 Standard for LV AC Power Circuit Protectors Used in Enclosures

Withdrawn IEEE Standards Projects

PC37.010f Circuit Breakers for GIS Applications
PC37.30f Switching Impulse Test; Definitions
PC37.39 Standard for Interrupter Switches for Alternating Current, Rated Above 1,000 Volts
PC37.40c Standard Definitions for Full Range Current Limiting Fuse
PC37.41h Standard Design Tests for Full Range Current Limiting Fuse
PC37.48b External Capacitor Fuses
PC37.48d Standard Application, Operations and Maintenance Guidelines for Full Range Current Limiting Fuse
PC37.70 Auto Switch Operating Mechanisms

TRANSFORMERS
New IEEE Standards Projects

PC57.130 IEEE Trial-Use Guide for the Use of Dissolved Gas Analysis During Factory Temperature Rise Tests for the Evaluation of Oil-Immersed Transformers and Reactors

Withdrawn IEEE Standards Projects

PC57.119 Recommended Practice for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Rating

TRANSMISSION & DISTRIBUTION
New IEEE Standards Projects

P1564 Recommended Practice for the Establishment of Voltage Sag Indices

Withdrawn IEEE Standards Projects

P655 Guide for the Design of Overhead Power Lines with Respect to Corona
P539 Standard Definitions of Terms Relating to Corona and Field Effects of Overhead Power Lines
P1126 Guide for the Control and Protection of HVDC Transmission Systems

TEST AND DIAGNOSIS FOR ELECTRIC SYSTEMS (SCC20)

Withdrawn IEEE Standards Projects

P1226.9 Standard for Software Interface for Resource Classes for a Broad Based Environment for Test (ABBET)
P1226.10 Standard for Software Interface for Tuntime Services for a Broad Based Environment for Test (ABBET)

TIME AND FREQUENCY (SCC27)

Revised IEEE Standards

P1193 Guide for Measurement of Environmental Sensitivities of Standard Frequency Generators

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Meeting Notice

ASAP 2000
12th International Conference on Application-specific Systems, Architectures and Processors

Boston, Massachusetts
July 10-12, 2000

The conference will cover the theory and practice of application-specific computing systems. Of particular interest are contributions that either achieve large performance gains, present formal methods for the specification, design and evaluation, analyze technology dependencies and the integration of hardware and software components, or describe and evaluate fabricated systems.

Areas for application-specific computing systems are many and varied. Some sample areas include information systems, signal and image processing, multimedia systems, high-speed networks, compression, cryptography.

Aspects of application-specific computing systems include, but are not limited to:

Application-specific architectures:

- Special purpose designs, design methodology, CAD tools, fault tolerance strategies, specification and interfaces, hardware/software co-design
- Application-specific processors: digital signal processing, computer arithmetic, configurable/custom computing, implementation methodology & rapid prototyping, new technologies, fine-grain parallelism
- Application-specific systems: network computing, special-purpose systems for exotic applications, performance evaluation, standard software objects, languages, compilers, operating systems, hardware/software integration

The conference will feature a keynote speech, paper presentations, and a poster session. The proceedings will be published by IEEE Computer Society Press.

asap@eecs.lehigh.edu.

General Chair:
Earl Swartzlander
e.swartzlander@compmail.com
Program Chairs:
Graham Jullien
jullien@uwindsor.ca
Michael Schulte
mschulte@eecs.lehigh.edu

Second International Software Assurance Certification Conference (ISACC 2000)

September 24-26, 2000

Hyatt Regency Hotel,
Reston Town Center,
Reston, Virginia
http://www.isacc.com

Theme: Issuing Software Certificates of Quality
General Chair:
Dr. Gary McGraw
(gem@rstcorp.com)
Program Chair: Dr. Jeffrey Voas
(jmvoas@rstcorp.com)
Conference Manager:
Jen Norman
(jnorman@rstcorp.com)

ISACC 2000 is the second international conference in an annual series to be devoted exclusively to the topic of software certification. Its predecessor conference, ISACC'99, was held in March of 1999 and was a major success, attracting researchers, academics, practitioners, government officials, and industry executives.

Today, enormous pressure is driving the search for technologies, tools, methodologies, and models that can certify software. Why? Because it is imperative that users know a priori whether deployed software will "behave as advertised." Similar to last year's conference, ISACC 2000 will be the key international forum where software users and publishers can exchange points of view on how best to certify software.

The theme of ISACC 2000 is "Issuing Software Certificates of Quality". ISACC 2000 will focus its attention on the different approaches toward "stamping" software with declarations of quality. As an example of such a declaration, the British Trade Marks and Service Marks Rules defines a "certified trademark" as "a mark adapted in relation to any goods to distinguish in the course of trade goods certified by any person in respect to origin, material, mode of manufacture, quality, accuracy or other characteristic, from goods not so certified."

By employing such a definition, a stamp of quality could be devised to differentiate good software from inferior software.

While ISACC 2000's theme is technical, it is equally important to recognize that the near-term prospects for software certification are largely driven by non-technical issues. Software is increasingly used in systems where failure threatens safety, economic loss, loss of privacy or confidentiality, and other injuries. ISACC 2000 is also greatly interested in addressing the legal/liability, social, and political impacts of certification.

ISACC 2000 will again explore the question of whether the government should mandate what the certification requirements are for given species of software systems, or whether "private-sector" developers should self-regulate via a core set of certification technologies. If self-policing is preferred, will it be by an honor system or will software certification laboratories be the means by which software vendors show that their software is of high quality?

In summary, the ISACC conference series seeks practitioners, attorneys, research scientists, industry executives, CIOs, and those that are interested in public policy to discuss ways in which software certification can be transformed from being viewed as a tax on the industry to being viewed as a trophy.

Topics of particular interest to the ISACC 2000 program can be divided into two categories and include:

- Certification Issues:
- Certification Authorities and Laboratories
- Certification Ethics
- Existing Software Standards (ISO, CMM, IEC, USNRC, FDA, NCSA, etc.)
- Government's Role in Software Quality and Consumer Protection Legislation
- Product vs. Process Certification vs. Personnel Licensing
- Software Liability
- Software Engineering Malpractice
- Software Insurance
- Software Warranties (Express and Implied)
- The Roles for Professional Organizations (ACM, IEEE, ASQ, etc.)
- Uniform Commercial Information Transactions Act
- US Congressional Policy and Upcoming Hearings

Technology Advances:

- Commercial-off-the-shelf (COTS) software quality
- Firewall certification
- Independent Verification and Validation
- Software Metrics and Measurement
- Software Validation
- Software Reliability Measurement
- Software Safety Assessment
- Software Security Assessment
- Testing/Verification and Validation

Workshop
Extending Commercial Off-the-Shelf (COTS) Software Research

Limerick, Ireland, 4-5 June 2000

This 1.5-day workshop is an extension of the work begun during the workshop entitled "Ensuring Successful COTS Development" held in conjunction with ICSE '99. The results from that workshop demonstrate that there are a number of common research areas, including planning and management, architecture and implementation, and evaluation and testing, for which researchers saw the possibility of collaboration. This workshop will continue the previous work by building on and expanding the application of research results from various areas of software engineering to the problems associated with building, acquiring, maintaining, and managing software systems containing COTS products.

Attendance at the workshop is based on the submission of a position paper. Experience reports that provide insight into the advantages and disadvantages of COTS adoption and integration are particularly welcome, as are position papers that may influence future software development processes and support tools. Attendees will be directed to breakout groups on the basis of their perceived contribution to the topics to be discussed, as demonstrated in their position paper. Some will also be invited to address the plenary session. Admission to the workshop will be open to all registered participants of ICSE 2000 who participate in the paper submission and selection process. Participants will register with ICSE 2000. Note that not all submitted papers will be selected for presentation, however, all applicants should submit a paper. Jointly authored papers are welcomed.

Preliminary Notice

Intelligent Transportation System Council (ITSC)

October 2-3, 2000

and

IEEE Intelligent Vehicles Symposium IV2000

October 4-5, 2000, Dearborn, MI

The following special sessions will be held during the symposium:

- Military Applications and Current Research
- organized by Bruce Brendle, U.S. Army Tank-automotive & Armaments Command organized by Christoph Stiller, Robert Bosch GmbH, Germany
- Autonomous Driving on Extreme Courses
- User Interfaces for On-Board Systems organized by Mauro Mosconi, University of Pavia, Italy
- Vehicle Motion Control Systems organized by Aurelio Piazzi and Corrado Guarino Lo Bianco, University of Parma, Italy
- Autonomous Vehicles Cooperation and Coordination organized by Giovanni Adorni, University of Parma, Italy and Hiroaki Kitano, Sony Computer Science Labs, Japan

Maastricht, the Netherlands, EU.

September 5th-7th

The symposium on Digital Systems Design addresses both architectures and implementations of embedded) digital systems as well as efficient design methods and tools. It is a discussion forum of the state-of-the-art research, development and applications for the research community working on computer system architecture, microprocessor architecture and design, logic design, application specific integrated processors, systems on a chip, hardware/software codesign, and design automation.

Topics include:

- CPU and memory architectures: arithmetic and logic units, co-processors, pipelining, superscalarity, cache, MMU.
- Special architectures: DSP, ASIPs, graphic and image processors, custom computing machines, processing arrays and FPGAs, reconfigurable structures.
- Specification and modeling: (hardware/software) system specification and modeling, system and hardware description languages, component modeling.
- Validation: simulation, emulation, prototyping and testing at the system, RT and logic level, multilevel- and co-simulation, formal verification.
- Synthesis: system on chip design; system, hardware-software, high-level, RT-level and logic synthesis, intellectual property and design reuse; synthesis for low-power, speed and testability; system, hardware/software and logic partitioning.

GENERAL INFORMATION ON EUROMICRO CONFERENCES
http://www.euromicro.org

IEEE Intelligent Vehicles Symposium

The Ritz-Carlton Hotel, Dearborn, MI, USA October 4-5, 2000

The IEEE Intelligent Transportation System Council (ITSC) is sponsoring a professional-level conference on basic research and present and future applications for Intelligent Vehicles and Intelligent Infrastructures. Papers dealing with vehicle-centered intelligent systems will be presented. This symposium is characterized by a single session format so that all the attendees remain in a single room for multilateral communications in an informal atmosphere. As another tradition, the meetings have enthusiastic participation from industry, as well as research centers and universities. The IEEE Conference on Intelligent Transportation Systems (ITS) will be held at the same location on Oct. 2-3, 2000, and a single -reduced rate-registration option will be available for both Conferences, as well as individual registrations.

TOPICS

- Driver Assistance Systems System Architectures Sensors
- Navigation/Guidance Systems Imaging and Vision Enhancement Vehicle Control
- Information Systems Human-machine Interfaces Active Safety
- Traffic Monitoring and Control Communications and Networks CAN

SPECIAL SESSIONS

Military Applications and Current Research

This session will provide an opportunity to explore research and development activities for autonomous and semi-autonomous ground vehicle systems. It examines the technology requirements and operational capabilities of robotic vehicle programs for military, and commercial applications. The session brings together technologists to discuss needs, opportunities and approaches for adapting commercial automotive intelligent systems to meet military off-road autonomous applications. The conference provides a unique opportunity to identify commercial research projects and leverage the results to meet crucial military requirements.

Topics:

- Government and Commercial programs: technical and performance challenges, system performance, test results, lessons learned;
- Machine perception for navigation and mission execution; Vehicle mobility and motion control;
- Operator interface and human-robot interactions.

Autonomous Driving on Extreme Courses

Theme:

Autonomous vehicle guidance in extreme driving environment. Coping with such conditions is a prerequisite for the introduction of advanced driver assistance functions. Hence, a discussion of the requirements and approaches to meet with these challenging conditions is expected to enhance insight into future developments, reveal missing links between current research and realization and provide impetus for new activities. The session will gather experts from various disciplines to shed light on the topic from different views.

Topics:

- System architecture, Multisensor systems, Advanced vehicle control,
- Driving strategy formation, Self-assessment, Reliability and Safety,
- Driving robot.

User Interfaces for On-Board Systems

Theme:

This session will focus on user interfaces issues in vehicle-centered intelligent systems and will feature experiences from the usability engineering perspective. Issues include, for instance, feedback, integration, synchronization, context, and how to make the most value from devices within vehicles: many of these are also issues for stand-alone systems, but mobility adds extra problems and opportunities. Those attending the session will be able to learn from and establish contacts with researchers who are innovators in developing human-computer interfaces.

Topics:

- Feedback, Feedthrough, Integration, Synchronization, Context,
- Multimodality, Design, Prototyping, Evaluation, Empirical studies.

Vehicle Motion Control Systems

Theme:

- This session will focus on control systems for autonomous vehicle motion.
- Longitudinal and lateral control strategies of car-like vehicles will be presented and the tight interplay with sensing systems (vision and nonvision based) will be highlighted.

Topics:

- Automatic steering control, Sensing systems, Visual guidance, Image dynamics estimation,
- Trajectory generation, Supervisory control, Advanced control systems design.

Autonomous Vehicles Cooperation and Coordination

Theme:

Cooperation and coordination of activities and actions are fundamental tasks when more than one agent is involved in accomplishing a complex common goal. During the last few years several projects have been started on such a topic. Among others, the European Handshaking (part of Prometheus Project) subproject where automobiles exchange information to better organize traffic flow; the Japanese rescue project for intervention of autonomous vehicles (robots) during catastrophic events; the international RoboCup initiative where a team of autonomous indoor vehicles (robots) have to coordinate their actions to implement a common strategy to compete against another team according to the soccer rules. The goal of the workshop is to focus on indoor and outdoor autonomous vehicles cooperation and coordination issues and related topics.

Topics:

- Fleets of indoor/outdoor autonomous vehicles,
- Autonomous vehicles cooperation,
- Team strategies for autonomous vehicles,
- Team coordination in challenging environments,
- Team competitions, Cooperative/competitive behaviors,
- Cooperative distributed perception.

IV-2000 Home Page:
http://www.ce.unipr.it/iv2000

TSC-2000 Home Page:
http://www.ewh.ieee.org/tc/its/cfp-itsc-2000.html

IEEE ITS Council Home Page:
http://www.ieee.org/its

Preliminary Notice

IFIP World Computer Congress ‘2000

Beijing, China

The Association for Computing Machinery (ACM) and the IEEE Computer Society (IEEE-CS) became full members of IFIP, the International Federation for Information Processing (www.ifip.or.at) in January, 1999.

WCC ‘2000 will be held August 21-25, 2000 in Beijing, China. It will be hosted by the Chinese Institute of Electronics, the China Computer Federation,

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IFIP
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and the Chinese Institute of Communication. The theme of the Congress is "Information Processing Beyond Year 2000." Together with various keynotes, panels, and workshops, the main technical components of the Congress will consist of eight federated conferences:

- ICCT: International Conference on Communication Technologies
- ICSP: International Conference on Signal Processing
- ICDA: International Conference on Chip Design Automation
- IIP: International Conference on Intelligent Information Processing
- ICEUT: International Conference on Educational Use of Technologies
- ITBM: International Conference on Information Technology for Business Management
- ICS: International Conference on Software — Theory and Practice
- SEC: International Conference on Information Security

More specific information about each conference can be found at *www.wcc2000.org*.

Preliminary Notice

SBCCI2000 - XIII Symposium on Integrated Circuits and Systems Design
CHIP IN THE JUNGLE

TROPICAL Hotel, Manaus, Amazonas, Brazil
September 18-22 , 2000
http://www.sbc.org.br/sbcci

The SBCCI is a forum dedicated to integrated circuits and systems design, held annually in Brazil. The location of its 2000 edition will be Manaus: gateway to the Amazon Rain Forest, flowers and animals paradise, and a wonderful cuisine make it a favorite tourists destination and provide a great environment for holding conferences and meetings.

SBCCI2000 will occur in the same venue as SBMICRO2000 - Congress of Brazilian Microelectronics Society. The goal of the symposium is to bring together researchers in the areas of CAD, synthesis, design and test of integrated circuits and systems. The IEEE Computer Society Press publishes the proceedings in time for distribution at the conference. Besides the traditional tutorials, regular technical sessions, round tables, working groups and exhibition, several activities are planned this year to encourage high quality contributions and enrich even more the meeting. The author of the best papers presented at the symposium will be invited to resubmit an extended version that will be considered for publication at the IEEE Design and Test of Computers Magazine.

A nice social program is being prepared, including a jungle excursion, with option to stay in a jungle resort (Ariau Hotel).

Topics of interest include, but are not limited to:

- Rapid Prototyping
- Design for Test
- Micro-architectures
- Logic and High Level Synthesis
- Digital, Analog and Mixed-Signal Designs
- Formal Methods
- Micro-Electromechanical Systems
- Hardware-Software Codesign
- Low-Power, Low-Voltage
- Embedded Systems
- Physical Design
- Design Environments
- Test and Testability
- Industrial Applications

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http://www.inf.ufrgs.br/~reis

Take a look at:
http://www.inf.ufrgs.br/gme

Preliminary Notice

FPL 2000
The 10th International Conference on Field Programmable Logic and Applications

28 - 30 August 2000
Villach, Austria

Future SoC - System on a Chip: impossible without Reconfigurable Subsystems

The conference proceedings will be published by Springer Verlag http://link.springer.de/series/lncs/

Topics to be covered include:

- Reconfigurable Hardware and Systems: Fine grain - Coarse grain - Reconfigurable Computing, Adaptive - Customizable - Embedded - fault-tolerant, Architectures - Technologies - Low Power - Dynamically Rec.
- Applications: Routing - Networking - Wireless - Evolvable Real-world - Scientific - Rapid-prototyping - Others
- CAD, Compilation, Testing and Verification: Design Flow - Tools - Higher Level Synthesis, Interconnect - Parameter Estimation - Benchmarks, Testing and Verification of Dynamically Reconfigurable Apps
- Surveys, Tutorials, Future, History, and Education: Roadmaps to Technology, Application and Design, Teaching Reconfigurables & Evolvables - Curricular Impact, Student Projects - Industry / University Programs - Publicity
- Evolvable Hardware and Evolutionary Compilation Methods: Evolvable Hardware (EH) - Co-Evolution, Tools and methodologies - Genetic Programming
- Emerging and Other RL/RC-related Methodologies: State machines - Cellular Automata, Biologically inspired - Brain inspired, fludic reconfigurable logic and applications, Molecular Biology Applications

For details on topic areas and conference location see:
http://xputers.informatik.uni-kl.de/FPL/FPL2000/detailed_fpl.html

Download Registration Form:
pdf: *http://xputers.informatik.uni-kl.de/FPL/fpl2000/CfP_FPL2000.pdf*
ps: *http://xputers.informatik.uni-kl.de/FPL/fpl2000/CfP_FPL2000.ps*

Reiner Hartenstein
Program Chair FPL-2000

RELEX Center Spread

RELEX Center Spread

Preliminary Notice

International Conference onCommunications, Computers and Devices ICCCD-2000

IIT-KHARAGPUR INDIA
Dec. 14-16,2000
Tutorials: Dec.14, 2000

This Conference is being organized by the Department of Electronics & Electrical Communication Engineering, IIT, Kharagpur on the eve of the Golden Jubilee of the Institute.

The topics of interest include:

- Telecommunications
- Switching and Networking
- Signal Processing
- Computers
- Pattern Recognition & Computer Vision
- Electromagnetics
- Photonics
- Electron Devices & VLSI Circuits
- Emerging & Next Generation Technologies in Communications,
- Computers & Devices

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International Reliability Physics Symposium Technical Program

The Technical Program will showcase 68 papers peer selected from the global microelectronics community and will present the latest findings in reliability physics and engineering. Dr. Tak Ning of IBM Research will open the symposium with a keynote address titled *Silicon Technology Directions in the New Millennium.*

This year the symposium will have world-renowned experts debate with the audience the following microelectronics issue: "***Is technology scaling limited by oxide reliability***". Please mark your calendar, bring your questions and don't miss out on this event.

Additionally the symposium will include our world class Monday tutorials program, which this year will feature 11 tutorials that provide in-depth presentations of important reliability issues. The Monday night workshops supplement the Technical Program and tutorials and provide an opportunity for informal, in-depth discussions in 10 topic areas. Please be sure to sign up for the workshops using the IRPS web page at *http://www.irps.org/ws/.*

As introduced last year, the Technical Program remains electronic. The initiative was well received by you the technical community, as over 75% of the total number of abstracts submitted were submitted electronically. Abstracts were received from all over the world and were reviewed by a team of 85 industry and academic experts in reliability engineering and physics. These committee members are all volunteers and their efforts in selecting very high quality papers for the symposium are to be commended. The Technical Program Committee is organized into sub-committees dealing with specific areas of reliability physics. This year's sub-committees focused on traditional favorites at the IRPS such as failure analysis, interconnects, device and process, ESD and latch-up, device dielectrics, and hot carrier aging, as well as newer areas of reliability concern involving plasma process induced damage, Copper/Low-K, and micro-electro-mechanical systems (MEMS), with a renewed emphasis on compound semiconductors. The compound semiconductor session includes an invited paper, introducing the reliability concerns associated with high field operation of Silicon Germanium Heterojunction Bipolar Transistors integrated in a high performance BICMOS technology.

The arrangement of paper sessions within the Technical Program reflects this sub-committee structure. The Technical Program begins on Tuesday at 8:15 a.m. The following Dielectrics plenary session discusses the latest advances in the reliability physics of thin insulators, and includes an analysis of energy controlled time-to breakdown versus the traditional physics oxide field breakdown. The remainder of the Program has been organized to include sessions consciously arranged to minimize overlap between subject areas. The Tuesday afternoon parallel sessions cover Dielectrics II, Hot Carriers, MEMS and Device and Process I. Hot Carriers covers analytical models useful in the deep sub-micron regime, LDD degradation, analysis of worst case mosfet stress conditions, and width dependencies on HER reliability.

MEMS reliability is a growing field, and this year will topically cover actuators, shock and vibration, and characterization techniques. The Wednesday morning parallel sessions begin with Device and Process II, and Packaging. Device and process I and II covers many exciting aspects of semiconductor reliability, including moisture effects, antifuse, flash, mosfet, yield correlation, SER susceptibility, metal anneal, Cu/Low-K, and oxide breakdown impact to mosfet operation. The packaging session discusses Analysis and simulation of BGA packages, Lifetime prediction for IGBT modules, stability of hall plates and the effect temperature cycling has on reliability prediction.

This session concludes with Compound Semiconductors, incorporating an invited SiGe paper, GaAs reliability, and optical fiber sensor reliability.

Wednesday afternoon has parallel sessions in ESD, which has the 1999 best ESREF paper describing ESD smart power reliability, and also includes discussions of protection using today's advanced dielectrics and metal systems. The parallel Interconnect session will contain interesting work on low-k inter level dielectrics, and copper interconnect integration issues.

Thursday reverts back to plenary sessions. The morning includes Process Induced Damage, which investigates various techniques and models to both detect and characterize damage using charge pumping, on-chip probes, and rapid ramp breakdown. The afternoon concludes with the invited Dielectrics panel discussion, and attendee questions. Thursday afternoon concludes IRPS 2000 with Failure Analysis where advances in defect based testing, novel probing techniques and process contributions to failures are discussed.

William R. Tonti
Technical Program Chair

Reconfigurable Technology: FPGAs & Reconfigurable Processors for Computing and Applications

To be held as part of: SPIE's Photonics East Symposium on Voice Video, and Data Communications

5-8 November 2000, Boston Massachusetts

The past decade has seen a dramatic increase in the use of reconfigurable logic devices in commercial applications. Among the most significant milestones in this field are the arrival of million plus gate logic devices and the introduction of a series of new reconfigurable processors. These devices are ideal for data-intensive, Internet, DSP, and other high performance embedded telecom and datacom applications.

Many systems engineers are using reconfigurable technologies to overcome computation and product development bottlenecks. The advent of million plus gate counts and advanced manufacturing techniques have made these reconfigurable devices more economical and practical for computing systems.

This conference, in it's fifth year, focuses on three areas of reconfigurable technology:

- New devices and systems
- Tools and techniques
- High-performance applications

The conference will present papers that illustrate applications and techniques for using reconfigurable technology in both design and production cycles. The following areas are considered:

- Field programmable devices
- Reconfigurable processors
- Programming tools and methodologies for reconfigurable devices & systems
- Applications and platforms utilizing reconfigurable technology for:
  - network & data intensive applications
  - hardware/software codesign
  - rapid product development
  - high-performance computing
  - image, signal, and communication processing
  - robotics
  - evolvable algorithms

Internet *http://www.spie.org/info/vv*

If you have any questions regarding the conference contact the Conference Chairman, John Schewel jas@vcc.com (+1 818-342-8294).

ISSRE'2000
The Eleventh International Symposium on Software Reliability Engineering

Doubletree Hotel, San Jose, California, USA
8th October - 11th October 2000

http://www.rstcorp.com/conferences/issre2000

In Collaboration with

The International Conference on Software Maintenance ICSM'2000

http://www.rstcorp.com/conferences/icsm2000

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

ABOUT ISSRE'2000

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 work-place automation, productivity enhancement, education, health-care, publishing, on-line services, and entertainment. 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'2000 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 2000 symposium will be "Applying Software Reliability". Like previous symposia, ISSRE'2000 seeks new results concerning today's software reliability problems. But ISSRE'2000 will give preference to papers focusing on the application of theory to the practice of reliability assessment. ISSRE'2000 has adopted this theme so that: (1) researchers can better hone their efforts toward the real problems expected in the next century, and (2) industry practitioners can describe real-world problems and the needed reliability technologies. 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 will include:

- Practical applications of reliability modeling
- Measurement for software reliability assessment
- Software reliability models
- Software testing and verification
- Software safety
- Fault-tolerant and robust software
- Reliability of distributed systems
- SRE tools, education, and technology transfer
- Software reliability standards and legal issues
- Building high-integrity mobile code systems

ISSRE'2000 and ICSM'2000 will feature an entire day — Industry Day — on 11 October 2000 dedicated to key companies describing how they perform software reliability engineering, maintenance, and testing. The initial list of participants follows:

- IBM Global Solutions
- NASA
- Nortel
- Sun Microsystems
- European Industry
- Italian Industry
- RST Corporation

Industry Day will be followed by a visit to the exciting Technical Museum of Innovation in San Jose for an evening of exhibits and dinner in the Communications Gallery: Global Communications and the Exploration Gallery: New Frontiers!

Call for Papers

Fifth IEEE International Symposium on High Assurance Systems Engineering (HASE 2000)

November 15-17, 2000, Albuquerque, New Mexico

Theme: Providing Convincing Evidence of Safety
http://www.high-assurance.org/

High Consequence Systems are systems whose state spaces contain failure states that are associated with unacceptable consequences (e.g., loss of life, loss of national security, unacceptable financial losses, etc.). By definition, high consequence failures are failures that, if necessary, system developers are willing to spend a considerable amount of energy, effort, and resources in order to avoid.

High Assurance Systems have demanding requirements either to ensure the safety of the users and environment or for economic survivability of the product. Requirements are typically in the form of safety, high reliability, permanent availability, real-time constraints, security, and fault-tolerance. Systems Engineering is a discipline that focuses on the processes, methods, and tools needed to design, implement, integrate, and test complete systems. It requires cross-disciplinary expertise, ranging from formal methods and software engineering to experimental validation and hardware design.

Before a system, high consequence or otherwise, is fielded "suitable assurance" (e.g., high assurance) must be provided that the system will not experience failure - or failing that, that the probability of experiencing a failure is "acceptably low". In the high consequence realm, providing "suitable assurance" that a system failure will be "acceptably low" can be extremely difficult. Unless great care is taken, providing "suitable assurance" approaches and often exceeds what is possible given current state of the art techniques (e.g., formal methods or first principle system design), and the term "acceptably low" translates to high reliability values that require extensive use of advanced reliability techniques. A promising approach to overcoming these problems is to integrate specific system engineering practices with suitable (complimentary) techniques for providing the necessary assurance that the specific high consequence system under consideration satisfies its requirements.

The HASE Symposium is a forum for discussion of systems engineering issues specifically relating to high consequence and high assurance systems. Examples of high assurance applications include large complex systems such as flight control systems, medical surgery equipment, unmanned air vehicles, military command and control, nuclear reactors, and secure telecommunication devices, as well as dedicated embedded systems such as vehicle braking, pacemakers, traffic-light control, MEMS, micro-robots, and satellites.

In the past, experts from industry and government R&D labs represented close to half the attendees, while academicians represented the other half. Our goal is to maintain and improve this interaction between government, industry, and academia through a high-quality program of research papers, panel discussions, demonstrations, focused workgroups, and presentations of case studies and experiences in systems engineering for high assurance embedded systems.

- Deadline for Submissions: May 31, 2000
- Notification of Acceptance: July 31, 2000
- Camera-ready copy due: August 31, 2000

For more information concerning general submission guidelines see:

http://www.computer.org/author/psguide.htm.

For more information concerning submission to HASE 2000 see:

http://www.high-assurance.org/

Topics of interest include, but are not limited to:

- Validation:
  - Validation of specifications
  - Fault-tolerant software design
  - Experimental and model-based evaluation
  - Assurance monitoring techniques
  - Real-time validation of existing systems
- Verification:
  - Formal modeling
  - Transformation-based system development
  - Case studies of practical applications of formal methods
  - Model checking
  - Real-time analysis and verification of existing systems
- Other:
  - Evolutionary design of complex systems
  - Hardware/software design tradeoffs
  - MEMS
  - Hardware architectures for high assurance systems
  - Software engineering for embedded systems
  - Security
  - Interoperability of secure systems

Submission Categories

Research Paper [max 15 pages], primary for academicians, describing original research results and prototype development.

Experience Paper Abstracts [max 2 pages], primarily for practitioners to re-

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IEEE

2000 *International*

INTEGRATED RELIABILITY WORKSHOP

October 23-26, 2000 http://www.irps.org/irw/ **Stanford Sierra Camp, Lake Tahoe, CA**

CALL FOR PAPERS

The Integrated Reliability Workshop continues to focus on ensuring semiconductor reliability through component fabrication, design, characterization, and analysis tools. It provides a unique environment for envisioning, developing, and sharing reliability technology for present and future semiconductor applications.

Hot reliability topics of the workshop are: Cu interconnects, reliability of deep sub-micron, high speed, high frequency devices, new dielectric systems, and reliability modeling & simulation.

We invite you to submit a presentation proposal that addresses one or more of the following topics:

- **WAFER LEVEL RELIABILITY TESTS AND TEST APPROACHES:**
  fast stress tests and analysis methodologies, reduction in development time, in-line monitors, relation to circuit-element and package-level tests, use and interpretation of WLR data; success stories; the fine tuning of a WLR implementation.
- **IDENTIFICATION OF RELIABILITY EFFECTS:**
  failure mechanisms and sensitivities to materials and manufacturing; new reliability aspects of: novel dielectric systems, Cu interconnects, MOS and bipolar transistors.
- **NEW OR EXISTING RELIABILITY CHARACTERIZATION AND PREDICTION MODELS TO SHOW:**
  limits to accelerated stress, (non-) correlation of short- and long-duration stress results, applications for AC, pulsed, and DC conditions.
- **RELIABILITY TEST STRUCTURES:**
  design, characterization, uses, and data analysis; for chip or package level (including electrical and/or physical test/analysis).
- **CUSTOMER PRODUCT RELIABILITY REQUIREMENTS/ MANUFACTURER RELIABILITY TASKS:**
  limits to achieve future reliability targets, reliability evaluation methodologies; reporting systems; data bases.
- **DESIGNING-IN RELIABILITY (CIRCUITS, PROCESSES, PRODUCTS):**
  methodologies and concepts, modeling, simulation tools, reliability-driven design rules and checkers; use of WLR for design rule verification.

SUBMISSION DEADLINE: ***Received no later than June 30, 2000.***

Your submission should state clearly and concisely the results of your work and why they are significant. Representative data and/or figures that support your proposal are REQUIRED.

Preferably, please e-mail your maximum two-page abstract (incl. figures) or airmail (express mail preferred) it with 15 copies to the Technical Program Chair. If you send the proposal by e-mail, please send it as a MS Word document or .pdf file. Your proposal must include the name, affiliation, complete return address, telephone and telefax numbers, and e-mail address for each author. Telefax submissions will NOT be accepted. All submissions will be acknowledged within three weeks. If you do not receive acknowledgment of your submission, please contact the Technical Program Chair.

Visual aids for the ACCEPTED proposals are required by September 8, 2000 for inclusion in the Presentation Handout available at the workshop. A written version of your presentation is due at the workshop for inclusion in the Final Report.

MAIL TO: Andreas Martin, Technical Program Chair, IRW 2000
Infineon Technologies AG
Otto-Hahn-Ring 6
81739 Muenchen
GERMANY

Tel: ++ 49 89 234 45257
Fax: ++ 49 89 234 45822
e-mail: Andreas.Martin@Infineon.com

2000 IRW ADVANCE REGISTRATION • October 23–26, 2000 • Stanford Sierra Lodge

Advance Registration should be made well before September 2000 to insure your space at the Workshop.

THE WORKSHOP HAS LIMITED SPACE (for approx. 130 attendees) and YOU ARE ENCOURAGED TO REGISTER EARLY.

The Registration fee is US$925 for IEEE Members and US$975 for non-members, which includes: meals, lodging, and refreshments at the Stanford Sierra Camp; Presentation View Graphs (provided at the Meeting); and the 2000 IRW Final Report (published after the Meeting).

LODGING & FACILITIES

Nestled throughout the pines and cedars along the shoreline of Fallen Leaf Lake, a few miles from South Lake Tahoe, are clusters of 2 and 3 bedroom cabins furnished in the rustic style of an alpine resort. Each cabin cluster is equipped with shared bathroom facilities. All rooms have decks with magnificent views of Fallen Leaf Lake and surrounding Sierra peaks.

The physical isolation of the location and the absence of distractions, such as in-room phones and television sets, encourages extensive interaction among the Workshop attendees.

Lodging is available for meeting attendees only.

JEDEC JC-14.2 MEETING

The JEDEC JC-14.2 Committee on Wafer Level Reliability meeting will be held immediately after the Workshop at the Stanford Sierra Camp on Thursday afternoon and Friday morning. Members, alternates, and guests are welcome. The cost for the accommodations is US $160.00, which includes Thursday night dinner and lodging *and* Friday breakfast and lunch. All attendees must leave the camp after lunch on Friday. If you have any questions, please call Michael Dion at (407) 724-7067. If you want to become a member of JC-14.2, please call the JEDEC office at (703) 907-7558.

INTEGRATED RELIABILITY WORKSHOP ADVANCE REGISTRATION FORM

(Please type, print or attach business card) *Meeting registration automatically includes a room reservation.*

NAME: ______________________ TITLE: ______________
Last First Initial

COMPANY: ______________________ Mail Stop

ADDRESS: ______________________

____
City State/Country Zip/Postal Code

Phone: (____) ____________ Fax: ____________

Email: ______________________

☐ Address is HOME

☐ Please check here if you do <u>not</u> wish to receive mail other than from IRW & IRPS

☐ Please check here if under the Americans With Disabilities Act, you require any auxiliary aids or services. Please call (315) 339-3968.

For cabin assignments: ☐male ☐female

Method of Payment: ❑Check: Make checks payable to: **2000 IEEE/IRW**
❑Credit Card: ❑AMEX ❑MASTER CARD ❑VISA ❑Diners Club

Card No. ____________ Expiration Date ____________ Signature ____________

ADVANCE REGISTRATION FEES

IEEE Member ____________ ... **$925*** ________
(member No. Req'd)

NON-IEEE Member .... **$975*** ________

** Includes meals, lodging, Handout, & Final Report. (Mon. eve., Oct. 23–Thur. noon, Oct. 26)*

<u>EXTRA</u> COPIES of Workshop Final Report ...... Qty: _____ x **$80** ________

JC-14.2 Mtg. accommodations **$160** ________

TOTAL REMITTED $ ____________

Cancellation fees: $50 after Sept. 25 ; full fee after Oct. 9

Send this completed form and payment to:
IRW Registration; P.O. Box 308; Westmoreland, NY 13490

Paying by credit card... fax to 315-336-9134;
Questions? sar@ntcnet.com or 315-339-3968

HISTORY

The Wafer Level Reliability Workshop was initiated in 1982 through the efforts of O. D. "Bud" Trapp, of Technology Associates, and the active support and encouragement of DARPA (Defense Advanced Research Projects Agency). This support continued for the first eight years of the Workshop and included active support and involvement of the Stanford University Integrated Circuits Laboratory and the University of California, Berkeley, Dept. of Electrical Engineering and Computer Sciences. After DARPA sponsorship ended, Bud Trapp continued the direction of the Workshop until 1991 after which time he requested that sponsorship and management be assumed by an appropriate professional association. The IEEE accepted this responsibility in 1992. In 1993, the name of the Workshop was changed to the Integrated Reliability Workshop. This change reflects the enlarged scope of the Workshop, the integrated nature of reliability in the manufacture of semiconductor products, and the need for a broader and a more comprehensive approach to reliability engineering.

ELECTRON DEVICES SOCIETY

The IEEE Reliability Society

SPONSORS

The International Integrated Reliability Workshop is sponsored and managed by the IEEE Electron Device Society and the IEEE Reliability Society through the Board of Directors of the International Reliability Physics Symposium.

http://www.irps.org/irw

INTERNATIONAL CONFERENCE ON COMMUNICATIONS, COMPUTERS & DEVICES

Dec. 14-16, 2000

Tutorials : Dec. 14, 2000

Department of Electronics & Electrical Communication Engineering
Indian Institute of Technology, Kharagpur 721 302, INDIA

ICCCD 2000

Everything You Always Wanted to Know about Silicon-Germanium: but Were Afraid to Ask!

14th December 2000 - ONE DAY Short Course on SiGe Microwave ICs for Wireless Communications Systems

Instructor: Prof. Dr.-Ing. H. Schumacher, Univ. of Ulm, Germany

The short course (Code:SiGe) will cover:

- Physical concepts of SiGe heterostructure devices
- SiGe technology
- Passive devices on Si substrates
- SiGe HBTs in low-noise and power amplifiers
- MMIC design techniques using SiGe-HBTs
- Application aspects : ICs ranging from 1-20 GHz.

This course has been offered extensively in Europe under the EU "Europractice" in Copenhagen/Denmark, Orsay/France, and Cambridge/UK and will be the FIRST COURSE of its kind in India. The audience would be people familiar with foundations of semiconductor devices and circuits, but not SiGe experts.

Instructor: Hermann Schumacher received his Dipl.-Ing. and Dr.-Ing. degrees from Aachen University of Technology, Aachen, Germany, in 1982 and 1986, respectively In 1986, he joined Bellcore of Red Bank, NJ as a Member of Technical Staff. In 1990, he joined the University of Ulm, Germany, as a professor. His research includes SiGe devices and technology, Si-based RF/microwave devices and circuits. Dr. Schumacher is a member of IEEE and VDE, and has authored or co-authored two book contributions, and more than 100 journal articles and presentations at international conferences.

Short Course (Code:SiGe) Registration Fee :

Category	Student	Author	Non-Author
Indian	Rs.800	Rs.1500	Rs.3000
Foreign	US$75	US$150	US$300

Draft should be made favoring:
ICCCD-2000
on Syndicate Bank IIT Kharagpur
Dateline:SEPTEMBER 30, 2000

Short Course registrants can purchase additional CD-ROM specially made for the Short Course with relevant papers and background materials. The CD-ROM will also include copies of important papers in the field (about 10-20 papers in PDF). Short Course registrants can order the CD for Rs.500/US$50 along with the Short Course registration fee (prepayment for the CD is essential with Registration Fee).

For further information, please contact:

Professor C K Maiti
Coordinator- Short Course (Code: SiGe)
Dept. of Electronics & ECE
IIT Kharagpur 721302 India
E-mail: ckm@ece.iitkgp.ernet.in
Fax: +91 (0) 3222 55303
Website: http://www.iitkgp.ernet.in/ccd2000

Technical Magazine Section

A Summary of the Reliability Aspects of Photovoltaic Devices and Systems

Philip Tsung
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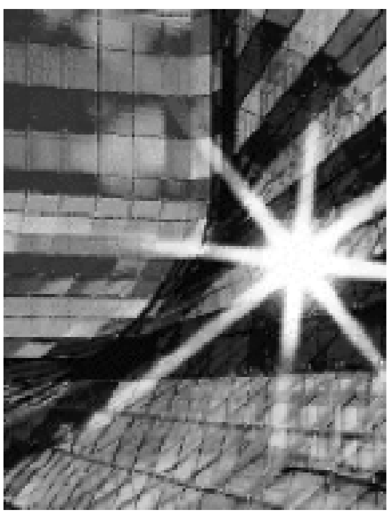
15251 Don Julian Rd
City of Industry, CA 91745-1002

Kenneth P. LaSala, Ph.D.
KPL Systems
703 Cannon Road
Silver Spring, MD 20904-3323



IEEE Spectrum Connection

Sept. '99 issue PHOTOVOLTAICS, Gaining Greater Visibility
By John P. Benner & Lawrence Kazmerski

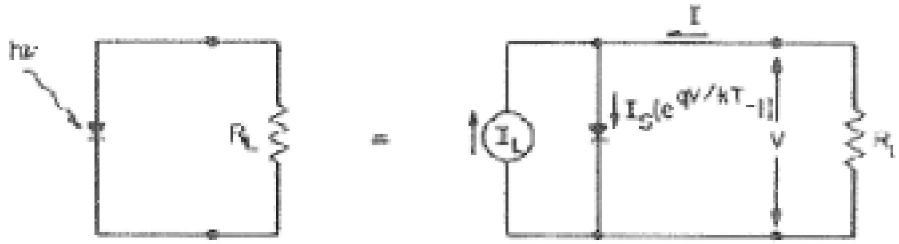
Established as a reliable source of electricity in small, out-of-the-way applications, photovoltaics technology is looming larger in public awareness as systems are installed in large urban centers. A range of techniques is under development, ranging from the tried-and-true single-crystal silicon to materials rolled out in sheets. Picture Credit: Kiss+Cathcart, Architects

This newsletter article supplements the September '99 issue with information that is important to reliability engineers. It is one in a continuing series of articles that provide reliability information on current technology topics in IEEE literature.

Basics of Photovoltaics:

A solar cell is a p-n semiconductor material. When a solar cell is not illuminated, it acts as a p-n junction (diode). When it is illuminated, the minority carriers dominate and the reverse current exceeds the forward current across the p-n junction, thereby making the solar cell a generator of current and power rather than a dissipator of current and power. A simple circuit diagram is shown below, where h represents incident light shined on the solar cell.

Two important measures for a solar cell are efficiency and maximum power. Efficiency is the measure of a cell's ability to convert sunlight into electricity. The maximum power point is the point on the solar cell's I-V curve corresponding to the maximum power, as shown in the figure below where the size of the rectangle representing the product of current and voltage is maximized.



Range of applications

There are three primary application classes for solar cells: 1) commercial products such as calculators and toys, 2)

continued on page 30

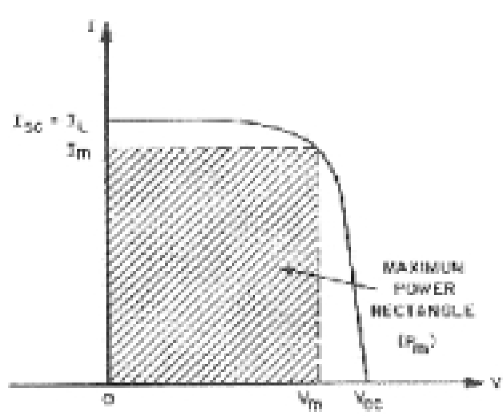
A Summary...
continued from page 29

terrestrial power modules, and 3) space satellite power modules. This paper addresses solar cells for space satellite applications, as this is the application where reliability is of the utmost importance. Specifically, this paper discusses solar cell design and materials, reliability, manufacturing, and qualification testing with an emphasis on reliability aspects.

Design and Materials

For many years, silicon was the primary material used for solar cells. First used in single-crystal form, silicon also has been used in polycrystalline form to obtain current photovoltaic cells with efficiencies almost as high as the single-crystal cells. Amorphous crystalline cells are being explored because their thin-film configuration uses less material and is suitable for large scale manufacturing. One problem with amorphous silicon is that it degrades over time when exposed to light. One can minimize this effect by engineering layer thicknesses and by using multiple junction structures. Efficiencies above 10% have been achieved with silicon, but the units are very sensitive to contaminants. Minor corrosion can destroy the device. In recent years, Gallium Arsenide (GaAs) on Germanium (Ge) substrate has offered significantly higher cell efficiencies (silicon cells achieving approximately 17% efficiency and GaAs cells achieving greater than 20% efficiency).

The drive to increase efficiency has included alterations to the basic configuration of a cell. The basic cell is a simple layering of materials. Recently, more advanced cell configurations have introduced a textured surface that consists of inverted pyramids and sophisticated anti-reflection coatings. At the present time, these advanced configurations are expensive to produce.



Reliability

For space applications, solar cell failure rates are difficult to establish with a high degree of confidence because a) the failure rates are too low to be measured accurately, and b) product is not returned for analysis. According to the Solar Cell Array Design Handbook [Ref. 1], the open circuit failure rate for a solar cell is estimated at 1 failure per billion hours of operation (i.e.1 FIT). This is based on orbital performance data of solar arrays. Therefore, most solar cell manufacturers use 1 FIT as a default value for its solar cells, as it is considered an industry standard in the U.S. satellite industry.

For panel and array level reliability analysis, the primary failure mode of concern is a cell open circuit. Because 1 FIT is an estimate of an open circuit condition, this failure rate is used regardless of cell technology (e.g. silicon vs. GaAs, single junction vs. multi junction).

A solar panel is comprised of solar cells configured in circuit strings. The voltage of each string is kept constant at the satellite bus voltage, and each string contributes current. At the circuit string (comprised of x number of cells in series) and solar panel levels (comprised of y number of strings in parallel), a new reliability model was developed to ensure that solar panels were not "over-designed" in terms of reliability. The power margins that were designed into the product were factored into the reliability model at the solar panel level. The reliability model was based on active redundancy where "m of n" solar cell strings have to work in order for the panel power requirements to be met, with "n" being the total number of cell strings and "m" being the number of cell strings that must work. Typically, at least one of the cell strings is allowed to fail for purposes of reliability analysis. The reliability model is shown below.

$$R_{STRINGS} = \sum_{k=m}^{n} [n!/(k!(n-k)!)] [R]^{k} [1-R]^{n-k}$$

- R is the reliability of an individual string consisting of cells, interconnects, and diodes (the reliability of each string in a panel is the same for purposes of this analysis)
- m is the number of strings that must work to meet the reliability requirement
- n is the total number of strings
- Power Margin (i.e. n/m)

When they do fail, photovoltaic cells exhibit several failure modes in descending frequency of occurrence [Ref. 2]:

1. Cracked/fractured
2. Encapsulant delaminated
3. Interconnect failure
4. Dielectric breakdown
5. Corroded
6. Unsoldered interconnects.

Manufacturing

The major manufacturing steps for solar cell production are listed below:

- Metal Organic Chemical Vapor Deposition (MOCVD) Growth – grow layers to form a p-n junction on the substrate (e.g. silicon, Gallium Arsenide (GaAs).
- Photoresist – Apply evaporation mask using positive photoresist and then align and expose patterns on positive photoresist using light source.
- Develop Front – Develop grid lines and ohmic areas by removing the photoresist on these areas.
- Window Layer Etch – remove front layers (e.g TiOx) from front metal contact area so that grid lines and ohmic areas directly contact the substrate.
- Front Contact Evaporation – evaporate metals onto surface of the cell which will form the grid lines and ohmic areas.
- Front Contact Lift Off – remove any remaining photoresist and unwanted contact metals.

- Back Contact Evaporation – evaporate metals onto back surface of the cell to produce back layer contact.
- Anti Reflective (AR) Coating – deposit a multi-layer anti-reflective (A/R) coating on the active area of the solar cell.
- Sinter Contacts – heat, or sinter, the contacts so that the gold layer applied during evaporation is made into an alloy with the substrate.
- Dicing – saw, or dice, wafer into finished part size.
- Solder or Weld Contact Area – solder or weld contact area to prepare cell for interconnection on the panel.

SPC, Cpk indices, and control charts are extensively used at individual manufacturing steps to ensure the highest quality.

Qualification Testing

In the satellite solar cell industry, there are stringent product assurance and qualification requirements at the solar cell and solar panel levels to ensure that solar cells will meet the power requirements over the life of the satellite (typically ranging from 5 to 7 years). For example, TECSTAR, Inc., a leading U.S. manufacturer of high efficiency Gallium Arsenide (GaAs) solar cells based in City of Industry, CA, qualifies its solar cells to ensure solar cell reliability to its customers (including Lockheed Martin, Loral, Orbital Sciences, NASA, Toshiba, NEC Corp., and Fokker Space).

At the solar cell level, the following qualification tests are performed at TECSTAR:

- <u>Electron Radiation</u> 1MeV energy level for 5E13, 1E14, 5E14, 1E15, 3E15 fluences (e-/cm2)
- <u>Humidity</u> at 95% relative humidity and 45C for 30 days to ensure that the cell can be stored in humid environments
- <u>Weldability or Solderability</u> to ensure that the cell can withstand a weld to its contact pads
- <u>Contact</u> Pull to ensure that the contact pad is welded to the cell
- <u>Proton Radiation</u> at 0.2 MeV and 10 MeV energy levels ranging from 3E10, 1E11, 3E11, 1E12, 3E12, and 1E13 fluences (p+/cm2)
- <u>Active Surface</u> Absorptance to ensure that the cell absorptance over a specified light wavelength is within acceptable limits
- <u>Reverse Bias</u> to ensure the cell can withstand a reverse current during eclipse.

Additionally, qualification tests are performed at the Covered Interconnected Cell (CIC) level, which includes a coverglass and interconnects attached to the solar cell. These tests are summarized below:

- <u>Optical properties</u> to ensure the coverglass' absorptance and emittance properties over a specified light wavelength are within acceptable limits
- <u>Angle of Incidence</u> to ensure a minimum acceptable current when light is applied at different angles of incidence
- <u>Humidity</u> at 95% relative humidity and 45C for 30 days
- <u>Thermal Cycling</u> to ensure the CIC can withstand wide changes in temperature
- <u>Reverse Bias</u> to ensure the CIC can withstand a reverse current during eclipse
- <u>Ultraviolet radiation</u> to ensure the CIC can withstand long term exposure to ultraviolet rays
- <u>Interconnect Pull</u> to ensure that the interconnect weld or solder meets minimum strength requirements.

Finally, if the end product is a solar panel, then a panel coupon qualification is performed at the string level consisting of CICs that are laid down on a substrate and interconnected to form a circuit string. The coupon is qualified to a Geosynchronous Orbit (GEO) and a Low Earth Orbit (LEO) application. The primary concern is the coupon's ability to withstand temperature extremes when the satellite moves into and out of eclipses. For GEO, the temperature extremes are –175C to +100C; for LEO, the temperature extremes are –100C to +110C. Also, over a typical five year life, a GEO satellite can see up to 3,000 eclipses and a LEO satellite can see up to 27,000 eclipses. Specific coupon level tests are identified below:

- <u>Thermal cycling</u> to ensure the stringed CICs and interconnects can withstand extreme temperature changes
- <u>Reverse bias</u> test to check the coupon's ability to withstand reverse bias currents during eclipse periods.

When the requirements of each of these tests are met, the solar cell, CIC, and if necessary, the solar panel, are considered qualified for space usage.

References

[Ref. 1] Solar Cell Array Design Handbook, JPL SP 43-38 Vol. I, NASA Jet Propulsion Laboratory, Oct. 1976.

[Ref. 2] Reliability Analysis Center (RAC) FMD-91, Failure Distribution Summaries, Sep 1991, p. 3-143 (courtesy D. Dylis, RAC)

Excellent Web sites that describe photovoltaic technology and its uses can be found at: *http://aurora.crest.org*
http://www.pv.unsw.edu.au
http://ourworld.compuserve.com/homepages/bhuebner/how.htm
http://www.bp.cpm/bpsolar/tech.html

Biographies

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Philip W. Tsung is responsible for reliability engineering and statistics at the three divisions of TECSTAR Inc., a manufacturer of solar cells, solar arrays, avionics communication equipment, and aerospace actuation and control systems. He received his formal education at Cornell University, earning a BSEE, MEE, and MBA. Mr. Tsung is currently a member of the IEEE Reliability Society National AdCom (1998-2000) and is a past chair of the Boston Chapter of the IEEE Reliability Society (1996-1997). He is an ASQ Certified Reliability Engineer.

Kenneth P. LaSala, Ph.D.

Kenneth P. LaSala is the director of KPL Systems, an engineering consulting firm, and is the System Engineering Staff Manager, Systems Acquisition Office, for the National Oceanic and Atmospheric Administration (NOAA). He has managed engineering groups and served as a senior technical staff member in sys-

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tems engineering, reliability and maintainability (R&M), and product assurance for the Air Force, the Navy, the Army, the Defense Mapping Agency, and NOAA. Also, he has served as the U.S. representative to NATO AC/250, Subgroup IX (Reliability and Maintainability). Currently, he is the President of the IEEE Reliability Society and the chairman of the IEEE Reliability Society Human Performance Reliability Committee. His publications include several papers on R&M, system requirements analysis, and other engineering topics and a chapter on human-machine reliability in the McGraw-Hill *Handbook of Reliability Engineering and Management* and an IEEE video tutorial, and a MIL-HDBK-338 section on the same topic. His research interests include techniques for designing human-machine systems and progressive system engineering approaches. He received the B.S. degree in Physics from Rensselaer Polytechnic Institute, the M.S. in Physics from Brown University, and the Ph.D. in Reliability Engineering from the University of Maryland.

PRISM - A New Approach To Reliability Assessment

Background

The premise of traditional methods of reliability predictions, such as MIL-HDBK-217, is that the failure rate of a system is primarily determined by the components comprising the system. Historically, a significant number of failures also stem from non-component causes such as design deficiencies, manufacturing defects, inadequate requirements, induced failures, etc., that have not been explicitly addressed in prediction methods.

The data in Figure 1 contains the nominal percentage of failures attributable to each of the eight identified predominant failure causes based on data collected by the Reliability Analysis Center.

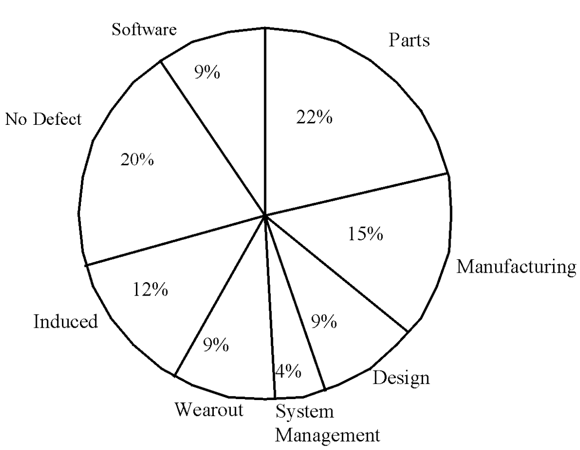

Figure 1: Failure Cause Distribution of Electronic Systems

In 1994, the U.S. Military Specifications and Standards Reform initiative decreed the adoption of performance based specifications for acquiring and modifying weapon systems. This led to the cancellation of many military specifications and standards. This, coupled with the fact the Air Force has re-directed the mission of the Air Force Research Laboratory (the preparing activity for MIL-HDBK-217) away from reliability, resulted in MIL-HDBK-217 becoming obsolete, with no government plans to update it.

The RAC believes that there is a need within the industry for a reliability assessment technique that can be used to estimate the reliability of systems in the field. A viable assessment methodology needs:

- Updated component reliability prediction models.
- A methodology for quantifying the effect that non-component variables have on system reliability.
- To be useable by typical reliability engineers with data that is readily available during the system development process.

In response to this situation, the Reliability Analysis Center has developed a new methodology, and an associated software tool called PRISM, for estimating the failure rate of electronic systems. This methodology includes new component reliability prediction models and means for assessing the reliability of systems due to non-component variables. The system assessment methodology was developed from an Air Force study performed by the RAC and Performance Technology to overcome some of the perceived limitations of MIL-HDBK-217.

Methodology Overview

The PRISM methodology is illustrated in Figure 2. The methodology is structured to allow the user the ability to estimate the reliability of a system in the early design stages when little is known about the system. For example, early in the development phase of a system, a reliability estimate can be made based on a generic parts list, using default values for operational profiles and stresses. When additional information becomes available, the model allows the incremental addition of data.

The purpose of PRISM is to provide an engineering tool to assess the reliability of electronic systems. It is not intended to be the “standard” prediction methodology, and it can be misused if applied carelessly. It does not consider the effect of redundancy or perform FMEAs. The intent of PRISM is to provide the data necessary to feed these analyses.

The methodology allows modifying a base reliability estimate with process grading factors for the following failure causes: parts, design, manufacturing, system management, wearout, induced and no defect found. These process grades correspond to the degree to which actions have been taken to mitigate the occurrence of system failure due to these failure categories. Once the base estimate is modified with the process grades, the reliability estimate is further modified by empirical data taken throughout system development and testing. This modification is accomplished using Bayesian techniques that apply the appropriate weights for the different data elements.

Advantages of this new methodology are that it uses all available information to form the best estimate of field reliability, is tailorable, has quantifiable confidence bounds, and has sensitivity to the predominant system reliability drivers.

The new model adopts a broader scope to predicting reliability. It factors in all available reliability data, as it becomes available on the program. It thus integrates test and analysis data, which provides a better prediction foundation and a means of estimating variances from different reliability measures.

System Reliability Model

The failure rate model for a system is as follows:

$$\lambda_P = \lambda_{IA} (\pi_P\pi_{IM}\pi_E + \pi_D\pi_G + \pi_M\pi_{IM}\pi_E\pi_G + \pi_S\pi_G + \pi_I\pi_E + \pi_N + \pi_W\pi_E) + \lambda_{SW},$$

where

λP = predicted failure rate of the system

λIA = initial assessment of the failure rate. This failure rate is based on new component failure rate models derived by the RAC, whose derivation is summarized in the next section

π_P = part process multiplier

π_{IM} = infant mortality factor

π_E = environmental factor

π_D = design process multiplier

π_G = reliability growth factor

π_M = manufacturing process multiplier

π_S = system management process multiplier

π_I = induced process multiplier

π_N = no-defect process multiplier

π_W = wearout process multiplier

λ_{SW} = software failure rate prediction

λ_{IA}, the initial assessment of the failure rate, is the seed failure rate value which is derived by using a combination of component reliability prediction models and the failure rate data contained in the RAC databases. This failure rate is then modified by the pi factors that account for specific processes used in the design and manufacture of the system along with the environment, reliability growth and infant mortality characteristics of the system.

The above failure rate expression represents the total failure rate of the system, which includes induced and cannot duplicate failure causes. If the inherent failure rate is desired, then the induced and cannot duplicate pi factors should be set to zero, since they represent operational and not inherent failure causes.

Initial Failure Rate Estimate

An initial estimate of the failure rate is based on a combination of the new "RACRate" failure rate models developed by RAC, the empirical field failure rate data contained in the RAC databases, or user-defined failure rates entered directly by the user. This initial failure rate represents a "typical" system and "average" processes. It is then adjusted in accordance with the process grading factors, infant mortality characteristics, reliability growth characteristics, and environmental stresses. In addition, software is modeled as a separate failure rate.

Process Grading Factors

An objective of the PRISM system model is to explicitly account for the factors contributing to the variability in traditional reliability prediction approaches. This is accomplished by grading the process for each of the failure cause categories. The resulting grade for each cause corresponds to the level to which an organization has taken the action necessary to mitigate the occurrence of failures of that cause. This grading is accomplished by assessing the processes in a self-audit. Any or all failure causes can be assessed and graded. If the user chooses not to address a specific failure cause, the model simply reverts to the default "average" value. If the user chooses to apply the grading methodology for any failure cause, there are a minimum number of questions that must be assessed and graded. Beyond this minimum, the user can selectively assess and grade additional criteria. If answers to the grading questions are not known, the model simply ignores those criteria.

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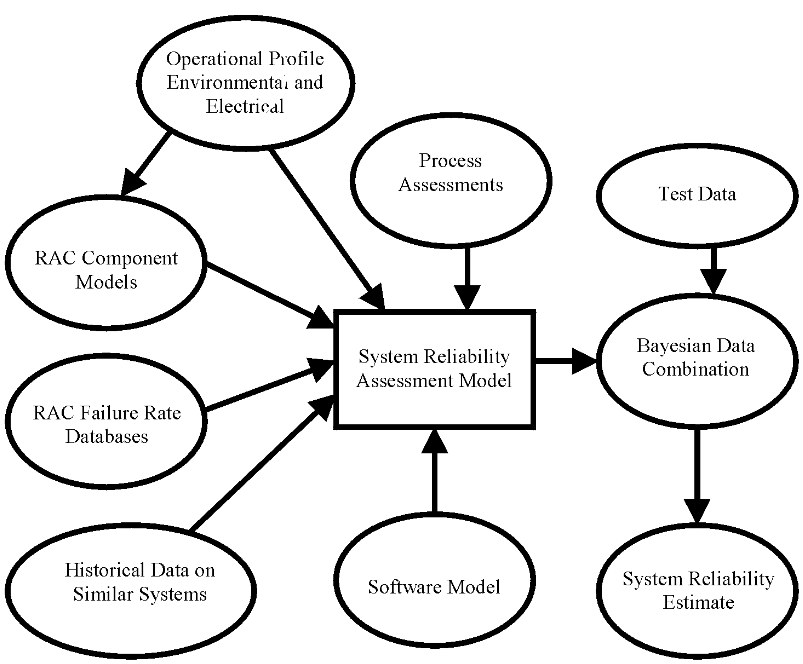

Figure 2: PRISM Methodology

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Process grading is used to quantify the following factors: π_P (parts process multiplier), π_D (design process multiplier), π_M (manufacturing process multiplier), π_S (system management process multiplier), π_I (induced process multiplier), π_N (no-defect process multiplier), and π_W (wearout process multiplier).

The sum of the p factors within the parenthesis in the failure rate model is equal to unity for the average grade. For example, the nominal percentage of failures due to parts is 22%. Therefore, π_P is equal to .22 if an average process grade (50th percentile) is obtained. Likewise, it will increase if "less than average" processes are in place and decrease if better than average processes are in place.

Environmental Factor

A factor is also included in the model to account for the environmental effects of vibration and temperature cycling. The RACRate component models used to derive the lIA value consider the effects of temperature cycling at the component level, and pE addresses the temperature cycling and vibration effects at the system level.

If the specific environmental stresses to which the system will be exposed in field use are known, then the environmental correction factor is

$$\pi_E = \frac{P_{TC} \bullet SS(TC_{USE}) + P_{RV} \bullet SS(RV_{UDE})}{P_{TC} \bullet SS(TC_{Gb}) + P_{RV} \bullet SS(RV_{Gb})},$$

where:
P_{TC} = percentage of failures resulting from temperature cycling stresses
P_{RV} = percentage of failures resulting from random vibration stresses
SS = screening strength applicable to the application environmental values.

If the actual values of these variables are unknown, the default values that should be used are P_{TC} = .80 and P_{RV} = .20.

The SS value is the screening strength and has been derived from MIL-HDBK-344. It is the probability of both precipitating a defect to failure and detecting it once precipitated by the test. Since the component failure rates described above are relative to a ground benign environment, the failure rate multiplier is the ratio of the SS value in the use environment to the SS value in a ground benign environment.

Whenever possible, the actual values of delta T (ΔT) and vibration (G_{rms}) should be used for the use application environment. The PRISM software tool includes defaults for these values as a function of the generic environment in the event that the model user does not know the specific environmental stresses to which the system will be exposed.

Reliability Growth

The PRISM model also includes a factor for assessing the reliability growth characteristics of a system. The premise of the factor is that the processes that contribute to system reliability growth in the field may or may not exist. The degree to which it exists is estimated by grading factors that assess the processes contributing to growth. The growth factor is

$$\pi_G = \frac{1.12(t\_2)^{-\alpha}}{2^{-\alpha}}$$

The denominator in the above expression is necessary to insure that the value of the factor is 1.12 at the time of field deployment regardless of the growth rate (a). Figure 3 illustrates the growth factor for various values of growth rates as a function of time.

The a value is estimated by determining the degree to which there exists growth potential. This estimation is accomplished in a manner similar to the process grading methodology by assessing and grading the processes that can contribute to reliability growth.

Infant Mortality

Infant mortality is accounted for in the model with a time variant factor that is a function of the level to which ESS has been applied. The infant mortality correction factor, π_{IM}, is

$$\pi_{IM} = \frac{t^{-.62}}{1.77} SS_{ESS}$$

where
t = time in years
SS_{ESS} = the screening strength of the screen(s) applied, if any.

The above expression represents the instantaneous failure rate. If the average failure rate is desired for a given time period, this expression must be integrated and divided by the time period.

Software Reliability Assessment

Modern electronic systems typically contain significant amounts of software. Therefore, for a reliability assessment tool to be complete, it must include provisions for the estimation of software reliability. Many of the existing software reliability models are estimation models that require empirical test data. In many

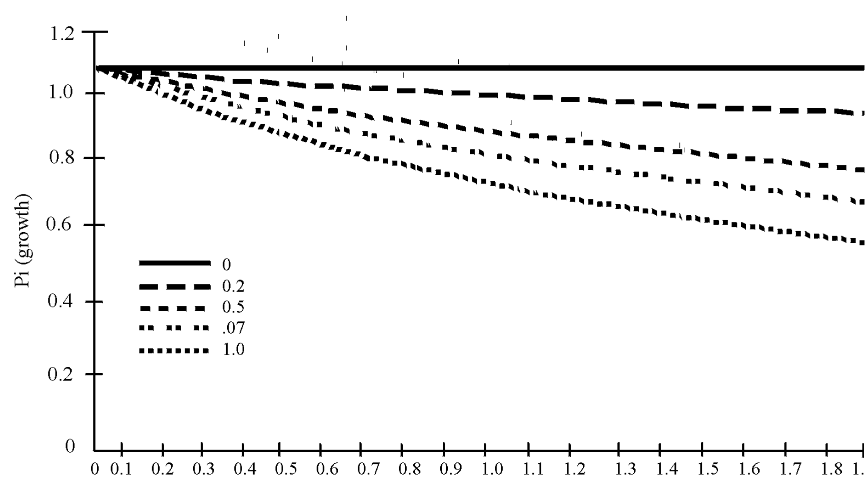

Figure 3: pG vs. Time and Growth Rates

cases, data is simply not available at a point in time when a reliability estimate of a system is needed. Therefore, it was necessary to develop a predictive software reliability model that does not require empirical data. Like the hardware models, the technique must be based on readily accessible data and information.

Like the hardware model presented previously, the premise of the model is that the inherent fault density of software can be estimated as a function of the processes. However, in the software model, a separate process grading criteria is not included. Rather, due to its acceptance within the industry, the SEI (Software Engineering Institute) Capability Maturity Model (CMM) is used for this purpose. Once the inherent fault density is estimated as a function of the CMM level, it is then converted to a failure rate based on the operational profile of the software.

Reliability growth characteristics are modeled in a manner similar to that of hardware. For example, the potential for reliability growth is assessed and the likely failure rate impact as a function of time is estimated. Both the growth rate and the stabilization time are estimated for this purpose. The default time for products to plateau and stabilize their residual fault content is typically 48 months for an initial release. Subsequent product releases, such as a new software version, typically take 24 months to stabilize. In the case of software, this reliability growth is a function of the organization that will perform the field maintenance, which may be different than the development organization.

Development of Component Reliability Models

Model Form

Traditional methods of reliability prediction model development have included the statistical analysis of empirical failure rate data. The statistical methods typically result in a model form that is multiplicative (i.e., the predicted failure rate is the product of a base failure rate and several factors that account for the stresses and component variables that influence reliability). An example of a multiplicative model is as follows

$$\lambda_p = \lambda_b \pi_e \pi_q \pi_s,$$

where
λ_p = Predicted failure rate
λ_b = Base failure rate
π_e = environmental factor
π_q = quality factor
π_s = stress factor.

A primary disadvantage of the multiplicative model form is that the predicted failure rate value can become unrealistically large or small under extreme value conditions (i.e., when all factors are at their lowest or highest values). This is an inherent limitation of multiplicative models, primarily due to the fact that individual failure mechanisms, or classes of failure mechanisms, are not explicitly accounted for.

The RAC believes that a better approach is an additive model that predicts a separate failure rate for each generic class of failure mechanisms. The appropriate stress or component characteristic then accelerates each of these failure rate terms.

This model form is as follows:

$$\lambda p = \lambda_o \pi_o + \lambda_e \pi_e + \lambda_c \pi_c + \lambda_i + \lambda_{sj} \pi_{sj},$$

where
λ_p = predicted failure rate
λ_o = failure rate from operational stresses
π_o = product of failure rate multipliers for operational stresses
λ_e = failure rate from environmental stresses
π_e = product of failure rate multipliers for environmental stresses
λ_c = failure rate from power or temperature cycling stresses
π_c = product of failure rate multipliers for cycling stresses
λ_i = failure rate from induced stresses, including electrical overstress and ESD
λ_{sj} = failure rate from solder joints
π_{sj} = product of failure rate multipliers for solder joint stresses

By modeling the failure rate in this manner, factors that account for the application and component-specific variables that affect reliability (p factors) can be applied to the appropriate additive failure rate term. Additional advantages to this approach are that they:

- Utilize existing RAC data collection infrastructure so that the models can be continuously updated as failure rate data is entered into the RAC databases
- Address operating, non-operating and cycling related failure rates in an additive model which are weighted in accordance with the operational profile (duty cycle and cycling rate). The pi factors modify only the applicable failure rate term, thereby eliminating many of the extreme value problems that plague multiplicative models
- Are based on observed failure mode distributions so that observed component failure causes are empirically modeled.

■ Model component reliability growth to allow the user to estimate the reliability of components manufactured today, if the user chooses to apply a correction.

- Are based on quantitative stresses rather than qualitative environmental categories, but default to average stress conditions as a function of environment.
- Are industry independent and predict the average failure rates of best commercial practices.
- Can be tailored with test data (if available).

Acceleration Factors

Acceleration factors (or pi factors) are used in the model to estimate the effect on failure rate of various stress and component variables. Since the traditional technique of multiple linear regression was not used in the derivation of the failure rate models, the pi factors were derived by utilizing either industry accepted values, values determined separately from data available to the RAC, or values from previous modeling efforts. For example, the models typically include both an operating and non-operating temperature factors based on the Arrhenius relationship, which requires activation energy for operating and non-operating conditions. To estimate these values

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for the model, previous modeling studies along with existing prediction methodologies were used. Similarly, some factors were based on test data. For example, the exponent used in the ΔT pi factor for integrated circuits is based on fallout rate data from temperature cycling tests that were performed at various levels of ΔT.

Time Basis of Models

Traditional reliability prediction models have been based on the operating time of the part, and the units were typically failures per million (or billion) operating hours. The RAC models predict the failure rate in units of failures per million calendar hours. This is necessary because it is the common basis for all failure rate contribution terms used in the model (operating, non-operating, cycling, and induced). If an equivalent operating failure rate is desired (in units of failures per million operating hours), the failure rate (in F/10^6 CH) can be divided by the duty cycle to yield a failure rate in F/10^6 operating hours.

Failure Mode to Failure Cause Mapping

There are two primary types of data on which the RACRate models are based; failure rate and failure mode. The model development process requires that the failure rate data be apportioned into failure cause categories. Since the failure mode data contained in the RAC databases is typically not in these categories, it was necessary to transform the failure mode distribution data into the failure cause distribution. This was accomplished by assessing the stresses that accelerate the specific class of failure categories, and estimating the percentage of failures that could be attributed to those stresses. The primary stresses that potentially accelerate operational failure modes are operating temperature, vibration, current and voltage. The stresses that accelerate environmental failure causes are nonoperating ambient temperature, corrosive stresses (contaminants/heat/humidity), aging stresses (time), and humidity. This data was collected by the RAC and is based primarily on failure analysis of parts that have failed in the field.

Derivation of Base Failure Rates

Once the pi factors were defined for each component type that was modeled, and once the failure rate was apportioned amongst the failure causes, the base failure rate could be determined. This was accomplished by gathering all failure rate data in the RAC database, estimating the model input variables (temperatures, stresses, etc.) for each source of data, calculating the associated pi factor for each failure rate, and deriving a base failure rate for each of the five failure cause categories.

For example, the failure rate associated with operational stresses equated to the product of the base failure rate and the operational pi factor is

$$P_{FC} \quad \lambda_{obs} = \lambda_b \pi_o$$

where

P_{FC} = percentage of failure rate attributable to operational failure causes

λ_{obs} = observed failure rate

λ_b = base failure rate to be derived

π_o = product of model pi factors

Solving for λ_b and adding a factor to account for data points which have had no observed failures yield where P_F is the percentage of total observed calendar hours associated with components that have had observed failures. This factor is necessary to pro-rate the base failure rate which was calculated from data records with failures. Once this value of λ_b was calculated for each data record, the geometric mean was used as the best estimate of the base failure rate. So far, a broad range of integrated circuits, capacitors, resistors, diodes, transistors and thyristors have been modeled.

Combining Predicted Failure Rate with Empirical Data

The user of this model is encouraged to collect as much empirical data as possible and use it in the assessment. This is done by mathematically combining the assessment made (based on the initial assessment and the process grades) with empirical data. This step will combine the best "pre-build" failure rate estimate obtained from the initial assessment (with process grading) with the metrics obtained from the empirical data. Bayesian techniques are used for this purpose. This technique accounts for the quantity of data by weighting large amounts of data more heavily than small quantities. The failure rate estimate obtained above forms the "prior" distribution, comprised of a0 and b0.

If empirical data (i.e., test or field data) is available on the system under analysis, it can be combined with the best pre-build failure rate estimate using the following equation.

$$\lambda = \frac{\alpha_0 + \alpha_l + \ldots \alpha_n}{b_0 + b_l + \ldots b_n}$$

where

λ = The best estimate of the predicted failure rate

a_o = The equivalent number of failures of the prior distribution corresponding to the reliability prediction (after process grading has been accounted for)

$$ao = .5$$

b_o = The equivalent number of hours associated with the reliability prediction (after process grading). After a0 is calculated, the value of b_0 can be calculated by

$$b_o = \frac{\alpha_0}{\lambda_p}$$

a_1 through a_n = The number of failures experienced in the empirical data. There may be "n" different types of data available.

b1 through bn = The equivalent number of cumulative operating hours (in millions) experienced in the empirical data. These values must be converted to equivalent hours by accounting for the accelerating effects between the test and use conditions.

If test data is available that was taken at accelerated conditions, it needs to be converted to the conditions of interest. A traditional reliability prediction can be performed at both the test and use conditions, and the equivalent number of hours (bi) can be determined from the failure rate ratio between the test and use temperatures.

$$H_{Eq} = \frac{\lambda_{TI}}{\lambda_{T2}} \bullet H_T$$

where

H_{Eq} = The equivalent number of test hours

λ_{T1} = Predicted failure rate at the test conditions obtained by performing a reliability prediction of system at the test condition

λ_{T2} = Predicted failure rate at the use conditions obtained by performing a prediction at the use conditions

H_T = Actual number of test hours.

Adding empirical data in the failure rate estimate…

- integrates all RAM data that is available at the point in time when the estimate is performed (analogous to the statistical process called "meta-analysis"),
- provides flexibility for the user to customize the reliability model with historical data.

Using the Model in a Top-Down Analysis

If empirical data exists on a predecessor system the equation that translates the failure rate from the old system to the new system is

$$\lambda_{new} = \lambda_{predecessor} \bullet \frac{\lambda_{predicted,new}}{\lambda_{predicted,predecessor}}$$

The (predicted, new) / (predicted, predecessor) failure rate ratio accounts for the differences in application environment, complexity, stresses, date, etc. The predicted failure rates for the predecessor and the new system, are determined using the complete detailed method. The observed predecessor failure rate is used as a baseline against which the new system failure rate is estimated.

Progressive Software Reliability Modeling

Craig Hyde
Samuel Keene

Software is typically the long pole in the tent in terms of its total contribution to system unreliability. Measuring software reliability or, more so, predicting software reliability is a challenge. This is especially true before the code is fielded. This paper recommends a practical approach to this challenge. A prediction model developed by Keene can be used to predict the software failure rate prior to code development [1].

The Keene model projects fault/density based upon empirical data correlating fault density to the development organization's Capability Maturity Level (CMM level). The model also transforms the latent fault density via an exponential reliability growth curve model into a predicted field failure rate.

The original software reliability modeling used Keene's Development Process Based Model. The key inputs to this model are the:

- SEI level for the developing organization,
- Number of months for the software failure rate to stabilize,
- Number of failure replications expected prior to fault removal,
- Fault activation rate,
- Percentage of all failures that are critical failures, and the
- Projected run time per month.

The reliability of the code has been observed to stabilize after four years in the field [2]. At that point, the software failure rate plateaus at a stable level. Subsequent releases of the code have been observed to plateau after two years in the field.

The Raleigh Model Fault Density Predictor

The Raleigh Model is the best tool to predict software reliability during devel-

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Project	Language	LOC	First Yr Defect Density Faults/KSLOC	Total Latent Defect Density Faults/KSLOC	Raleigh Estimate Defect Density Faults/KSLOC
A	Jovial	680K	0.3	0.6	0.6
B	PL/1	30K	3.0	6.0	6.0
C	BAL	70K	0.2	0.4	0.3
D	Jovial	1700K	0.4	0.8	0.9
E	ADA	290K	0.3	0.6	0.7
F	---------	70K	1.1	2.2	2.1
G	ADA	540K	0.6	1.2	1.1
H	ADA	700K	0.2	0.4	0.4

Table 1. Defect Removal Patterns and Raleigh Projections

Progressive Software

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opment. The Raleigh model is a member of the Weibull distribution with its shape parameter, m = 2. The exponential distribution is also a special case of the Weibull with the shape parameter, m, = 1. The Raleigh prediction model forward chains all the defect discovery data, collected throughout the development phases, to predict the software's latent fault density. (Latent errors are those errors that are not apparent at delivery but manifest themselves during subsequent operations. This is contrasted to patent errors, which are obvious by inspection.) The inputs to the Raleigh model are the defect discovery rates found in the following design phases: High Level Design, Low Level Design, Code and Unit Test, Software Integration and Unit Test, and System Test.

Kan has reported good agreement between Raleigh projected defect densities and field measured performance as measured across eight programs [3]. He reported:

Notice that Kan's data shows excellent agreement with the Raleigh prediction, without any bias in the estimator, to actual field experience. Also, the reliability growth shown in Table 1 for first year defects shows that 50% of the defects are removed the first year. Comparatively, Keene's model projects 56% of all latent defects will remain after 1 year. So Keene's model is a slightly conservative predictor of reliability growth vis-à-vis the actual data shown in Table 1.

Best Predictive practice.

First use Keene's Performance Based Prediction Model to estimate the software reliability. Then apply the Raleigh model over the development cycle to refine the latent fault density estimate. Upgrade the latent fault density estimate in the Keene model. Then use the Keene model and its exponential growth component to transform the latent software fault density into an operational reliability.

References

1. S.J. Keene, "Modeling Software R&M Characteristics," ASQC Reliability Review, Part I and II, Vol 17, No.2&3, 1997 June, pp.13-22.

2. Ram Chillarege, Shriram Biyani, Jeanette Rosenthal, "Measurement of Failure Rate in Widely Distributed Software," Fault Tolerant Computing Symposium (FTCS), 1995, page 424-433].

3. Stephan H. Kan, "Metrics and Models in Software Quality Engineering", Addsion-Wesley Publishing, Reading, Mass. 1995, p. 192.

4. John Musa et al, "Software Reliability, Measurement, Prediction, Application", McGraw-Hill, New York, 1988.

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lay experiences in creating high assurance systems. The abstract must discuss both strengths and weaknesses of the methods used for systems that have been built and deployed. Authors of accepted abstracts will have the opportunity to include a full paper in the proceedings.

Position Papers: [max 1 page]. Members who want to be considered for a panel session can submit a position paper that discusses their view of any issue pertaining to high-assurance systems. Persons with strong position papers will be selected to participate in a related panel session.

Panel Session Proposal [max 2 page overview, plus a 1-page position paper from each proposed panel member]. The proposal overview should introduce controversial issues related to systems engineering of high assurance systems. The position papers should be from panelists representing both sides. Panels should have 3 to 5 members, plus the chair. At least half of the allotted time for the session should be for questions and answers. Thus, each member will be allotted approx. 5 minutes to summarize their views on the debated issue. For the remainder of the time, the floor will be open to questions.

Special Track Proposal. [max 2 pages] An overview of the proposed track should include the authors and titles of papers that have been submitted to the symposium that the chair would like to include in this special track. If at least three of those papers are accepted, the special track will be granted, and the track chair will have the opportunity to ask one additional person to present an invited paper. Persons seeking these special tracks should try to encourage people in the area to submit papers, to provide them maximum choice and highest quality in selecting papers.

Focussed Workgroup Proposal. [max 1 page] A focussed workgroup consists of discussion by up to 10 people working in closely related areas, discussing possible new research issues or areas. At the symposium, each registrant will have the opportunity to participate in one of the selected focussed workgroups.

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President's Message

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publications in assisting our members in applying the reliability disciplines to new technologies. Our technical briefs may be published on our Web page (http://ewh.ieee.org/soc/rs) in ensure that they are readily accessible. The first two briefs are on information technology by Hank Wolf and photovoltaics by Phil Tsung and myself. I want to thank both Hank and Phil for their excellent efforts in producing their briefs. I encourage you to read them and to suggest other topics that might be interesting to the society members.

Our Technical Operations reorganization and Newsletter technical briefs are only two steps in the process of enhancing the value of Society membership. To help determine other steps, we will be sending out a member survey. Please respond quickly when you receive your copy. If you prefer to send your ideas before you receive the survey, use the e-mail address below. I certainly would enjoy receiving them.

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VEHICULAR TECHNOLOGY

New IEEE Standards Projects

P1558 Standard for Software Documentation for Rail Equipment and Systems

Revised IEEE Standards Projects

P1483 The Verification of Vital Functions in Processor-based Systems Used in Rail Transit Control
P1536 Standard for Rail Transit Vehicle Battery Physical Interface

Withdrawn IEEE Standards Projects

P905 Rail Transit Intra System EML