Reliability Society

NEWSLETTER

Vol. 50, No. 3, August 2004

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President s Message

Dear IEEE Reliability Society Members:

This note is to inform you several of the many changes that are being considered by the Institute. Since many of the potential changes on the table also affect the societies and councils. Here, I wish to inform you of some of the activities that are underway at the Institute and Technical Activities Board (TAB), and if possible, how those changes, if implemented, could affect our Society.

First, I'd like to thank our 3 special guests that participated in our July ADCOM meeting in Burlington. Dick Sacks participated representing the IEEE Systems, Man, and Cybernetics Society, Dr. Bret Michael represented the Naval Postgraduate School (and is person heading up our cyber-trust new initiative), and Matt Loeb, from the Institute, dialed in to participate. For more information concerning the results of the Burlington meeting, please review the minutes.

Secondly, IEEE is seriously reevaluating virtually every part of how it conducts business and grows market share. This includes aspects of publications, conferences, education, outreach, marketing, etc. For example, the transition away from paper publications to electronic presents a completely new set of challenges for how to sell that content. Recognize that the end-recipients of the revenue from those sales are the societies and councils who provide the content. Currently, the amount of money returned to the societies and councils is a function of how many pages of content a particular society delivers to the Institute in a given year as compared to the other organizations. However some societies prefer a revenue model where they are paid for each download of an article, because while they may not publish as much material, their content receives more readership than, and in particular, a larger societies with numerous amount of content.

Another interesting debate is at the TAB level. Today, all societies and councils get one vote, regardless of size. So for example, the Computer Society with its 80k+ members gets the same vote as we do, and we are under 2k in membership.

My point in mentioning these two examples is that as economics become more important, and competition increases for members between societies when people with multiple society memberships start dropping one or more to save on money, tensions arise for a way for each society to get either more power or more revenue. Fortunately, however, there still is much collaboration between societies, but as competition for membership and sales of society products increases, so will the tension.

And finally, one of the largest pieces of news to come out of the last TAB series was approval for IEEE to explore creating an exhibit at Disneyworld to attract kids to science and engineering. The approximate cost of this will be $9M, $3M of which will be born by the societies and councils if IEEE can find other sponsors for the remaining $6M. The TAB was generally very much opposed to this, but the Board of Directors overruled. Suffice it to say that our treasurer will be getting a large bill at some point if the other $6M is located. But it is undecided how that $3M burden will be allocated.

So in summary, the Institute and all of its organizational units are in a time of rapid change. And while not all of the proposals on the table will be implemented, it is clear that some will be implemented in 2005. And this makes it difficult for your ADCOM and all other Adcoms

to predict the future and react in reasonable time. This is one of the major complaints of all of the organizations but at least the Institute recognizes it and is trying to get information out faster.

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From the Editor

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

We welcome your articles, comments or questions. All RS Newsletter inputs should be sent electronically to l.chase@ieee.org.

February	***Inputs due January***
May	***Inputs due April***
August	***Inputs due July***
November	***Inputs due October***

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

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Special Announcement

NEW

Reliability Society moves to electronic (web-based) information distribution

Members can now access the following publications electronically by going to **IEEE Xplore?**and signing in using their IEEE member web accounts.

- **Reliability and Maintainability Symposium (RAMS) Proceedings**
- **International Reliability Physics Symposium (IRPS) Proceedings**

  Note: There is a 2 month delay for current year proceedings availability
- **Tranactions on Reliability**
- **Transactions on Device and Materials Reliability**

Members can go to the **What's My Access**page (a link on the Xplore Home Page) and they will see a list of the offerings available to them based on their society memberships. Direct links to the conference home pages will be provided there. Likewise, the subscription identifier feature allows users to know what PDFs are available to them at the time they are performing an article search (or any other), by use of an icon next to the article entry in their search results.

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Society Nominations

Reliability Society Engineer of the Year Award for 2004

The IEEE Reliability Society is soliciting nominations for its Reliability Society Engineer of the Year Award for 2004. This award is aimed to recognize key contributions to the Reliability profession within the last few years. Nominees will be considered according to the following criteria:

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

An administrative superior of the nominee (e.g. department head, supervisor, or chapter chair) should make and submit the nomination. The nomination package should consist of a one-half page biography of the nominee plus up to four pages of concise descriptions of the accomplishments. For technical contributions, please concisely describe why the contribution is unique. For managerial and educational contributions, please concisely explain the obtained benefits. Please limit identified publications to only those in which the nominee was the sole or principal author. The accomplishments should be organized according to the above-

described criteria. **The last date that nominations may be submitted is 1 October 2004. Send the nominations to Dennis Hoffman, your Society's Jr. Past President, at d.hoffman@ieee.org.**

Reliability Society Lifetime Achievement Award for 2004

The IEEE Reliability Society is soliciting nominations for its Reliability Society Lifetime Achievement Award for 2004. The IEEE Lifetime Achievement Award was created to recognize sustained outstanding contributions to the field of Reliability Engineering. Typically the contributions will span the career of the individual, usually in excess of 25 years. The contributions meriting this award must clearly be within the area of Reliability Engineering.

Nominations must be submitted by a peer or supervisor of the nominee. Self-nominations or nominations from a member of the IEEE Reliability Society Nominations and Awards Committee will not be accepted. The nomination package should consist of a one-half page biography of the nominee plus up to four pages of concise descriptions of the nominee s lifetime accomplishments / achievements. **Nominations may be submitted until the end of September 2004. Send the nominations to Dennis Hoffman, your Society's Jr. Past President, at d.hoffman@ieee.org.**

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Chapter Activities

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Technical Operations

Society Technical Committee Recruiting Notice

The IEEE Reliability Society national organization is recruiting technical committee members and possibly committee chairpersons for the following technical committees:
Software Reliability, System Safety Technology, Human Interface Technology, Mechanical Reliability, Standards & Definitions, CAD/CAE, Microelectronic Technologies, Industrial Systems, Sensor Systems, Information Technology & Communications, Consumer Electronics, International Reliability, Aerospace & Defense Systems, Testing and Screening Technology, Automotive Systems, Energy Systems, 6 Sigma Reliability, Medical Systems, Reliability Design, Warranty, Nuclear Reliability, Maintainability Technology, Assurance Technology, and Emerging (New) Technology.

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

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

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

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Assessing Reliability Risk Using Fault Correction Profiles

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Abstract

Building on the concept of the fault correction profile -- a set of functions that predict fault correction events as a function of failure detection events -- introduced in previous research, we define and apply reliability risk metrics that are derived from the fault correction profile. These metrics assess the threat to reliability of an unstable fault correction process. The fault correction profile identifies the need for process improvements and provides information for developing fault correction strategies. Applying these metrics to the NASA Goddard Space Flight Center fault correction process and its data, we demonstrate that reliability risk can be measured and used to identify the need for process improvement.

1. Introduction

There is a need for greater emphasis on fault correction modeling and prediction in software reliability models [XIE92]. This need stems from the fact that the fault correction process is vital to ensuring high quality software [SCH03]. If we only address failure prediction, reliability risk assessment will be incomplete because it would not reflect the reliability of the software resulting from fault correction. In addition, it is important to address the fault correction process in order to identify the need for process improvements. Process improvements, in turn, will contribute to achieving software reliability goals -- the well-known observation that process improvement will lead to product improvement [SCH99]. In [SCH03], we introduced the concept of a *fault correction profile* -- a set of functions that predict fault correction events as a function of failure detection events. The *fault correction profile* identifies the need for process improvements and provides information for developing fault correction strategies. Related to the *fault correction profile*, is the *goal fault correction profile* [SCH03]. This profile represents the fault correction goal against which the achieved *fault correction profile* can be compared. This comparison motivates the concept of *fault correction process instability*, and the attributes of instability [SCH03].

This paper consists of the following sections: 2. Abbreviations, 3. Definition of Terms, 4. Objective, 5. Research Approach, 6. Other Approaches to Modeling Fault Processes, 7. Fault Correction Profiles, 8. Prediction Accuracy, 9. Application, 10. Model Predictions, 11. Measuring Deviations from Goal Fault Correction Profiles, 12. Assessing Risk, 13. Summary, and 14. References.

2. Abbreviations

Actual (observed) Quantities

ct: Days from First Fault Closure (Closed Date)
CT: Fault Correction Time (Days)
ft: Days from First Failure
dct: Deviation from Closed Date (ct) Goal Profile
DCT: Deviation from Fault Correction Time (CT) Goal Profile

Predicted Quantities

Closed Date

PCD: Predicted Closed Date (ct)
d(PCD)/d (ft): PCD Rate of Change
Pdct: Deviation from Closed Date (ct) Goal Profile
d(Pdct)/d(ft): Pdct Rate of Change
RPCD: Closed Date (ct) Risk
d(RPCD)/d(ft): RPCD Rate of Change

Fault Correction Time

PCT*:* Predicted Fault Correction Time (CT)
d(PCT)/d(ft): PCT Rate of Change
PDCT: Deviation from Fault Correction Time (CT) Goal Profile
d(PDCT)/d(ft): PDCT Rate of Change
RPCT: Fault Correction Time (CT) Risk
d(RPCT)/d(ft): RPCT Rate of Change

Specified Quantities

gct: Goal ct Profile
GCT: Goal CT Profile
N: sample size, indexed by ft, used in formulating prediction equations.

3. Definition of Terms:

Closed Date: date when fault closed or *fault closed date* (3/26/1999 - 8/7/1999); this quantity is converted to days from first closure.

Failure Date: date when failure occurred (3/26/1999 - 4/21/1999).
Fault Correction: the process of identifying one or more faults that cause one or more failures, removing the faults from the software, *and* identifying and correcting problems in the development process that allowed the faults to be inserted in the software [SCH03, SCH04].
Fault Correction Profile: a set of functions and plots that characterizes the fault correction process for the purpose of identifying the need for process improvements and for developing fault correction strategies [SCH03].
Fault Correction Time: calendar time (days) required to correct a fault (closed date – failure date).
Goal Fault Correction Profile: a profile that represents the fault correction goal against which the achieved fault correction profile can be compared [SCH03].
Fault Correction Process Instability: a situation in which the *achieved fault correction profile* does not satisfy the requirements of the *goal fault correction profile* [SCH03].
Attribute # 1 of Fault Correction Process Instability: the value of ft at which a predicted or actual reliability risk metric, like closed date, increases at an increasing rate [SCH03].
Attribute # 2 of Fault Correction Process Instability: the value of ft at which a predicted or actual reliability risk metric, like closed date, exceeds the goal fault correction profile [SCH03].
Prediction Range: ft = 1, 195 days; N = 17: range of ft used to formulate prediction equations.
Predicted Range: ft = 1, 234 days; N = 19 (ft = 1, 195, N = 17; ft = 196, 234 N = 2: retrospective and prospective ranges of ft, respectively, to which prediction equations are applied).
Reliability Risk: risk that reliability goals (e.g. time to next failure, remaining failures) will not be achieved if there is an unstable fault correction process.
Reliability Risk Metrics: metrics like *closed date* and *fault correction time* that measure and assess the risk of not meeting the requirement of the *goal fault correction profile*.

Henceforth, when we use the term "risk", we will be referring to "reliability risk".

4. Objective

Our objective is to develop a model for predicting two quantities: 1) the risk to reliability caused by the delay between failure detection and fault correction dates (i.e., *closed date*)and 2) the risk to reliability caused by the time necessary to correct faults (i.e., *fault correction time*). The purpose of 1) is to identify whether fault correction *dates* (i.e., points in time) increase at an increasing rate relative to failure detection dates, and cause an increasing risk to reliability. The purpose of 2) is to identify whether fault correction *times* (i.e., duration) increase at an increasing rate relative to failure detection dates, and cause an increasing risk to reliability. If either 1) or 2) is the case, it is indicative of a fault correction process that should be examined for *possible* improvement. Note that no fault severity data was available for this project.

5. Research Approach

The theoretical basis of this paper is that we consider the fault correction process to be a non-linear system with feed forward path and time line from errors in software artifacts to faults in code to failures in execution. The feed backward path and time line consists of failure detection to fault correction to process improvement to eliminate the errors in the development and maintenance process that cause the errors in the software artifacts. The backward path has an inherent delay due to the time required to correct faults. In addition, an artificial delay may be introduced due to postponement of fault correction because some faults are not high priority at the moment, as in the case of the Space Shuttle [SCH01]. This is a deliberate polity of withholding fault corrections until a later release of the software [MUS99]. These factors contribute to the non-linear nature of the fault correction process. Specifically, this means the following: *fault closed dates* and *fault correction times*, relative to the first failure occurrence date, eventually increase at an increasing rate, with the passage of time. Therefore, we modeled the fault correction process with non-linear regression functions, specifically with third order polynomials. These functions increase at an increasing rate, as is the case with the actual data. In addition, these functions allow for local maxima or minima, as is also the case with the actual data.

6. Other Approaches to Modeling Fault Processes

This section contains a brief discussion of other selected approaches to modeling fault processes and the relationship to our research. Gokhale and colleagues have addressed the issue of delayed fault correction, when the delay is caused by the queuing of faults to be removed or by the presence of latent faults that are difficult to remove [GOK97]. However, this is not the same as the delay mentioned in Section 4 that is the result of a decision by the developing organization to defer fault correction until the removal of a fault becomes critical to the operation of the software. They also model the possibility of imperfect fault repair (i.e., a fault may not be entirely corrected or a new fault may be inserted during the repair operation) [GOK96]. They use a non-homogeneous Markov Chain to represent a non-homogeneous Poisson process to model failure detection and fault correction. Their approach is interesting and provides greater flexibility than analytical models like ours in a variety of fault correction scenarios. However, analytical models, like ours, provide greater

visibility of the relationships between factors that influence the fault correction process than do complex Markov Chain diagrams.

Investigations by Nikora and Munson have focused on identifying relationships between the measured structural evolution of a software system and the rate at which faults are inserted into it during development (i.e., the number of faults inserted per unit of structural change). To do this, a method of measuring software first had to be developed. In 1996, Munson and Werries presented a methodology for measuring software evolution that extended the notion of software complexity across sequential builds [MUN96]. Once a method of measuring software evolution had been developed, they were able to investigate the relationship between structural evolution and the fault insertion rate. Nikora and Munson [NIK98, MUN98] analyzed the flight software and software failure reports for the command and data handling subsystem of a NASA planetary exploration spacecraft, and found strong indications that measurements of a system's structural evolution could serve as predictors of the fault insertion rate. While structural evolution is a significant contributor to fault insertion rates, our focus is on *fault correction* and the reliability risk incurred with an unstable fault correction process, and not on fault insertion. In addition, there was no GSFC data available to support this type of analysis.

7. Fault Correction Profiles

In this section, we briefly describe and apply the *fault correction profile* to the GSFC fault correction process. The *fault correction profile* predicts reliability risk metrics (e.g., *fault closed date*) as a function of a failure detection metric (i.e., *failure detection date*). The *fault correction profile* provides very useful information for developing fault correction strategies. For example, PCD, *predicted closed date*, equation (1), has local maximum and minimum at 55 and 107 days, respectively, (see Table 1 and Figure 1). Figure 1 was obtained by doing *retrospective* prediction, using a sample of size N =17 (see Table 1). The predicted values of 55 and 107 days were obtained by solving equation (2), the derivative of (1) set equal to 0. These values predict when local values of *closed dates* reach a maximum (55 days) and a minimum (107 days). It is the latter that is of major interest because it identifies when the rate of change of PCD (equation (2)) transitions from negative to positive (i.e., increasing rate of change of PCD in the undesirable direction). This is an example of *attribute # 1* of *fault correction process instability*. For the example, as seen in Figure 1, this point is 107 days. *Instability could* be caused by a changing process, product, and personnel.

$$PCD=0.00011*ft^3-0.0268*ft^2+1.95012*ft-11.1605 \quad (1)$$

$$d(PCD)/d(ft) = 0.00033*ft^2 - 0.0536*ft + 1.95012 = 0 \quad (2)$$

7.1 Goal Fault Correction Profile

This profile represents the fault correction goal that the achieved *fault correction profile* can be measured against. For example, suppose the goal is to have all faults corrected within 200 days of the first failure. In addition, suppose another goal is a last *closed date* of 100 days since the first closure. Furthermore, since we have shown that *closed dates* that increase at an increasing rate are undesirable, a linear function of *closed dates*, with a constant rate of change of .5, starting at 0,0 and ending at 200, 100, would be appropriate for representing our goals. This is the *goal fault correction profile*, gct = .5*ft, as shown on Figure 1. When the actual *closed dates* are below the goal profile, the trend is favorable; conversely, when the values are above the line, the trend is unfavorable. We see in Figure 1 that the trend is mostly favorable; however, at ft = 195 days, *actual*, the trend has become distinctly unfavorable. This result provides further evidence that the fault correction process warrants investigation. This is an example of *attribute # 2* of *fault correction process* instability. To identify favorable and unfavorable trends, the *goal fault correction profile* can be compared to *PCD*, the predicted *closed dates*, in Figure1. We see that the two are equal at ft = 9, 61, and 169 days. Between 9 and 61 days, the actual *closed dates* are mostly above the *gct* line (unfavorable); between 61 and 169 days they are always below the *gct* line (favorable), and at 169 days (see Table 2), they start a rapid increase (unfavorable). These curve crossings are most useful when we are predicting beyond the range of the actual data, when only the predictor functions, like *PCD*, would be available.

7.2 Fault Correction Time Profile

A second *fault correction profile* example is *PCT*, the *predicted correction time* in equation (3), which has a local maximum and a local minimum at 20 and 143 days, respectively, (see Table 1 and Figure 2), obtained by solving equation (4), the derivative of (3) set equal to 0. Figure 2 was obtained by doing *retrospective* prediction, using a sample of size N =17 (see Table 1). The local minimum of 143 days indicates that the plot of equation (3) would continue to rise at an increasing rate in the range ft = 143, 195, as shown in Figure 2. This indicates a *possible* unstable fault correction process, according to *attribute # 1* of *fault correction process instability*, which should be investigated.

$$PCT=0.00011*ft^3-0.0270*ft^2+0.966912*ft+115.755 \quad (3)$$

$$d(PCT)/d(ft)=.00033*ft^2-.0540*ft-.966912=0 \quad (4)$$

Table 1. Fault Profile Characteristics (Data Set 1, Sample Size N = 17, ft = 1, 195 days)				
Predictor	**Units**	**R^2**	**Value of *ft* at local minimum**	**Average Residuals (between predicted and actual)**
Closed Dates (PCD)	Days from First Closure	.8861	107	-0.5072
Correction Time (PCT)	Days	.8614	143	0.2592
ft: Days from First Failure				

7.2.1 Goal Fault Correction Profile

As an example of a *Goal Fault Correction Profile*, consider the goal of correcting faults in an average of about two months, or 60 days. (The actual average for the sample size of 17, referred to in Table 1, is 81 days). Then, this condition can be portrayed as in Figure 2, where the *Goal Fault Correction Profile*, *GCT*, intersects *PCT*, the predicted fault correction times, at ft = 93 and 181days. We see that between ft = 0 and 93 days, the actual and predicted fault correction times are above GTC (unfavorable), and at 181 *predicted* (see Table 2) and 190 *actual* the trend has become distinctly unfavorable. Thus, there is evidence that *attribute # 2* of *fault correction process instability* has taken effect.

8. Prediction Accuracy

The R^2 values and average residuals for *PCD* and *PCT* are shown in Table 1. The purpose of R^2, along with residual plots, is to judge the goodness of fit between the predicted and actual data. The residual plots for *PCD* and *PCT* (not shown) do not show bias over the range ft = 1, 195 days.

9. Application

If these profiles hold for other software in the same domain, it could be used as an alarm to investigate the fault correction process for *possible* improvement. This process would be implemented by plotting the actual data points, along with making predictions, for example weekly, as shown in Figures 1 and 2, and observing whether the local maxima or minima occur. If the start of any unfavorable trends are observed, such as the predictions of ft = 169 days in Figure 1 and ft = 181 days in Figure 2, the fault correction process would be examined to determine the cause of instability. If this examination reveals that there are systemic problems in the process, remedial action is initiated to improve the process. Once sufficient data has been collected, the prediction equations (1) – (4) and their plots can be used to predict unfavorable *future* process events.

10. Model Predictions

10.1 Closed Date

Up to this point we have described *retrospective* predictions and developed fault correction profiles from them. As mentioned, these are important for sounding alarms concerning the quality of the fault correction process. However, it is also important to predict future fault correction events. With these in hand, software engineers can anticipate fault correction process problems and proactively undertake countermeasures (e.g., strengthen the testing process). We begin by presenting the results obtained by using *PCD*, equation (1), to predict beyond the range of Figure 1, which is a sample of size N = 17, averaged fault *closed dates*, in the range ft = 1, 195 days from the first failure. Figure 3 shows the full range of faults, N = 19, averaged fault *closed dates*, in the range ft = 1, 234 days from the first failure. Figure 3 compares the actual and predicted fault *closed dates* over the full range of faults. The R^2 is .9104 (.8861 for N = 17) and the average residuals are -8.5630 (-0.5072 for N = 17), as summarized in Table 2. The application of *PCD* is to use the fault data in the range 1, 195, to estimate the coefficients of equation (1), and then to predict fault *closed dates* in the range 196, T, where T would be determined by the total time allocated to fault correction from the first failure. In this example, T = 234 days. We observe that *PCD* does predict accurately that at ft = 169 days, the *Goal Fault Correction Profile* will be crossed at an increasing rate

10.2 Fault Correction Time

As in the case of using a sample of N = 17 for *PCD*, the same approach is used for *PCT*, the predicted *fault correction times* in equation (3), as shown in Figure 4. Thus, with a sample of N = 17, in the range ft = 1, 195 days, we predict fault correction times in the range ft = 196, 234 days. These results are summarized in Table 2, where we see that over the full range of the data, N = 19, the prediction accuracy of *PCT*, as given by R^2, is worse than that of *PCD*, but its residuals are lower. We observe that *PCT* does predict accurately that at ft = 181 days, the *Goal Fault Correction Profile* will be crossed at an increasing rate. Both predictors, *PCD* and *PCT*, should be used to identify *possible* instability in the fault correction process; we should not rely on a single metric One metric can be used to confirm the result obtained from the other metric.

Table2. Fault Profile Characteristics (Data Set 1, Sample Size N = 19, ft = 1, 234 days)				
Predictor	**Units**	**R^2**	**Value of *ft* where PCD or PCT = Goal Profile at an *Increasing Rate***	**Average Residuals (between predicted and actual)**
Closed Dates (PCD)	Days from First Closure	.9104	169	-8.5630
Correction Time (PCT)	Days	.7316	181	-7.2096
ft: Days from First Failure				

11. Measuring Deviations from Goal Fault Correction Profiles

11.1 Closed Date

The deviation between the *fault correction profile* and the *goal faul*t *correction profile* is plotted in Figure 5 for *closed date* for actual and predicted deviations. The deviations are computed by equations (5) and (6), respectively.

$$dct = gct - ct = .5*ft - ct \quad (5)$$

$$Pdct=gct-PCD=-0.00011*ft^3+0.0268*ft^2-1.45012*ft + 11.1605 \quad (6)$$

The roots of equation (6), where PCD = gct, are ft = 9 days, 65 days, and 169 days, as shown in Figure 1, where PCD = gct, and in Figure 5, where gct – PCD crosses the X-axis. We see that at ft = 169 days, *predicted* (see Table 2), and 183 days, *actual* (approximate), the deviations go negative (unfavorable); the deviations and the risk start to increase significantly. Of course, since the prediction range is ft = 1, 195 days, this would be a *retrospective* prediction. However, the *prospective* prediction in the range ft = 196, 234 days, as seen in Figure 5, suggests a highly unstable fault correction process (i.e., *attribute # 1* of *fault correction process instability*). Therefore, this prediction result calls for an investigation of the cause(s) of a rapidly deteriorating fault correction process.

In addition to the values of ft where PCD = gct, we want to predict the values of ft in equation (6) where a local minimum and a local maximum occur. This is accomplished in equation (7) and shown in Figure 5, where the roots are 34 days (minimum) and 128 days (maximum). The latter value, corresponding to a predicted local maximum, confirms the fact, *retrospectively*, that the X-axis crossing at ft = 169 days, is indeed the start of the deviation going negative.

$$d(Pdct)/d(ft)=-00033*ft^2+.0526*ft–1.45012=0 \quad (7)$$

11.2 Fault Correction Time

The deviations between the *fault correction profile* and the *goal faul*t *correction profile* are plotted in Figure 6 for *fault correction time* for actual and predicted deviations. The deviations are computed by equations (8) and (9), respectively.

$$DCT = GCT – CT = 60 – CT \quad (8)$$

$$PDCT=GCT–PCT=-0.00011*ft^3+0.027*ft^2- 0.966912*ft-55.755 \quad (9)$$

The positive roots of equation (8), where PCT = GCT, are ft = 93 days and 181 days, as shown in Figure 2, where PCT = GCT, and in Figure 6, where GCT – PCT crosses the X-axis. We see that at ft = 181 days, *predicted* (see Table 2), and 187 days, *actual* (approximate), the deviations go negative (unfavorable); the deviations and the risk start to increase significantly. Again, this would be a *retrospective* prediction in the range ft = 1, 195 days. Figure 6 shows a *prospective* prediction of a highly unstable fault correction process in the range ft = 196, 234 days.

In addition to the values of ft where PCT = GCT, we want to predict the values of ft in equation (9) where a local minimum and a local maximum occur. This is accomplished in equation (10) and shown in Figure 6, where the roots are 20 days (minimum) and 143 days (maximum). The latter value, corresponding to a predicted local maximum, confirms the fact, *retrospectively*, that the X-axis crossing at ft = 181 days, is indeed the start of the deviation going negative

$$d(PDCT)/d(ft)=-0.00033*ft^2+0.054*ft-0.966912=0 \quad (10)$$

12. Assessing Risk

We use the concept of risk relative to the *fault correction profile* in order to compare reliability risk metrics like *closed date* and *fault correction time*. We do this by normalizing the deviations, described above, with the *goal faul*t *correction profile*. The predicted *fault closed date* risk is defined in equation (11) and plotted in Figure 7. The actual values, dct/gct (not shown), follow a similar trajectory.

$$RPCD=Pdct/gct=-0.00022*ft^2+0.0536*ft-2.90024+ 22.3210/ft \quad (11)$$

We are interested in identifying the value of ft where RPCD has a local maximum because this is where RPCD starts to decrease rapidly and risk increases significantly. The rate of change of RPCD is given in equation (12).

$$d(RPCD)/d(ft)=-.00044*ft^3+.0536*ft^2-22.3210=0 \quad (12)$$

The root corresponding to the local maximum is ft = 118 days. Similarly, the predicted *fault correction time* risk is defined in equation (13) and plotted in Figure 7. The actual values, DCT/GCT (not shown), follow a similar trajectory.

$$RPCT=PDCT/GCT=(-0.00011*ft^3+0.027*ft^2- 0.966912*ft-55.755)/60 \quad (13)$$

Since RPCT is equation (9) divided by a constant, its rate of change d(RPCT)/d(ft), has the same roots as equation (10), where the local maximum is ft = 143 days. Thus, in comparing the *retrospective* predictions RPCT and RPCD (local maximum = 118 days), by looking at Figure 7, we see that RPCT lags RPCD. However, RPCT goes negative faster than RPCD, and thus, the *prospective* predictions indicate higher risk with the *fault correction time* metric. The implication of this result is that the *duration* of correcting faults is more important than the *specific dates* on which closure occurs, with respect to monitoring the fault correction process.

13. Summary

We have defined and applied reliability risk metrics that are derived from the *fault correction profile*, which was introduced in previous research [SCH03]. The risk metrics -- *closed dates* and *fault correction times* -- provide the software engineer with a method for measuring the deviations between these metrics and *goal fault correction profiles*. In addition, by normalizing the risk metrics by the *goal fault correction profil*e, we can compare the relative threat to the fault correction process, if the deviations increase in the unfavorable direction We applied these metrics to the NASA Goddard Space Flight Center (GSFC) fault correction process and its data and we demonstrated the feasibility of identifying *possible* problems in the fault correction process. Although other application domains may yield metrics that are different than the ones we identified using the GSFC data, the *principles* of our approach would remain the same.

14. References

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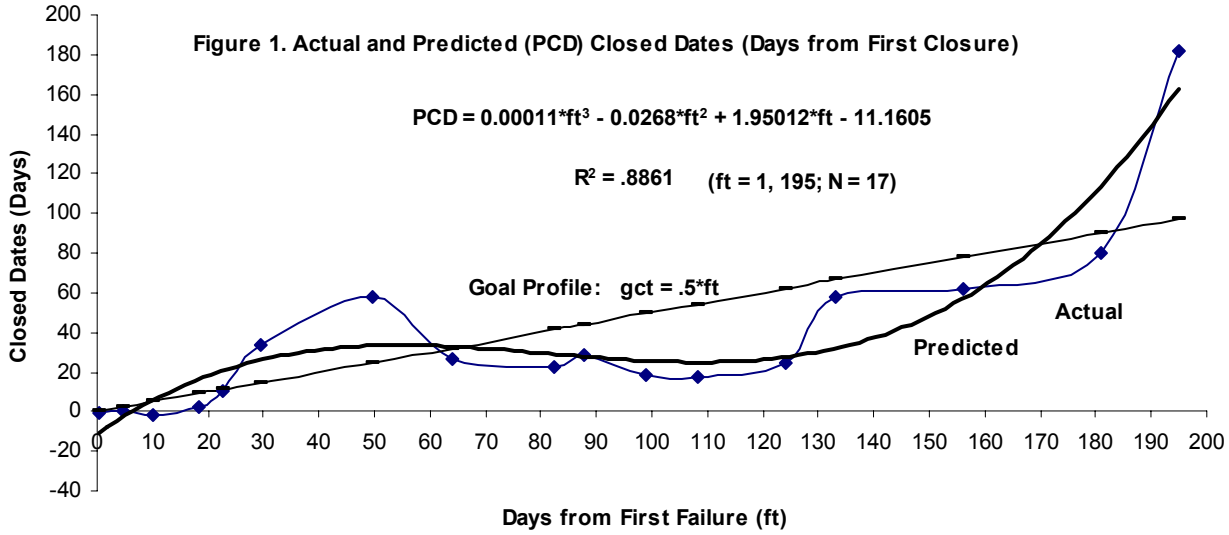


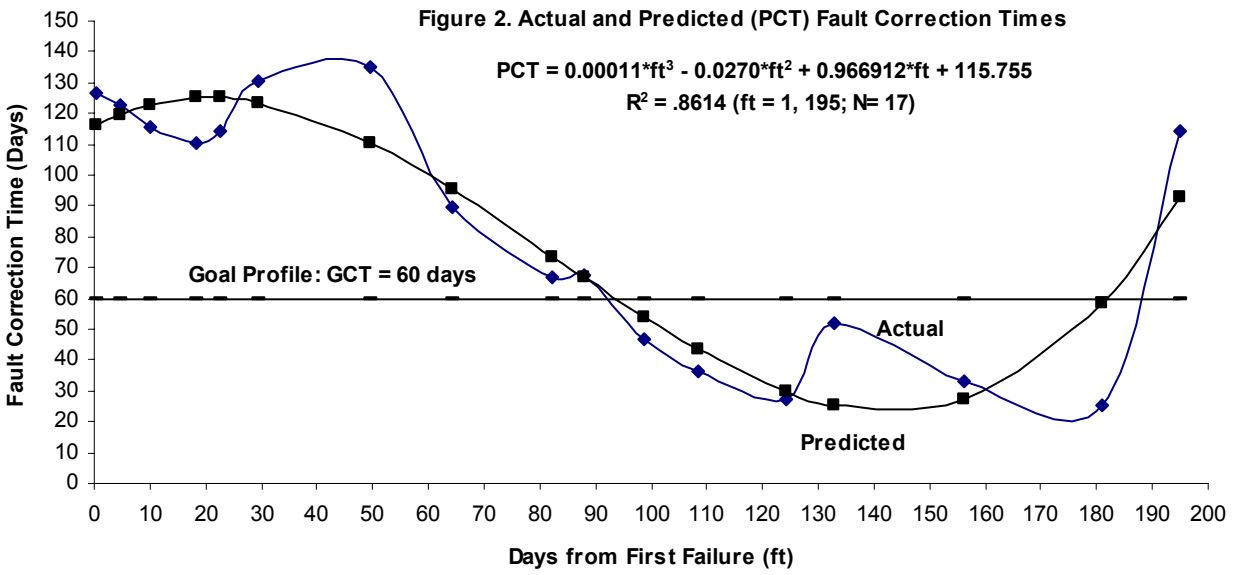


Figure 2. Actual and Predicted (PCT) Fault Correction Times
PCT = 0.00011*ft³ - 0.0270*ft² + 0.966912*ft + 115.755
R² = .8614 (ft = 1, 195; N= 17)
Goal Profile: GCT = 60 days
Actual
Predicted
Fault Correction Time (Days)
Days from First Failure (ft)

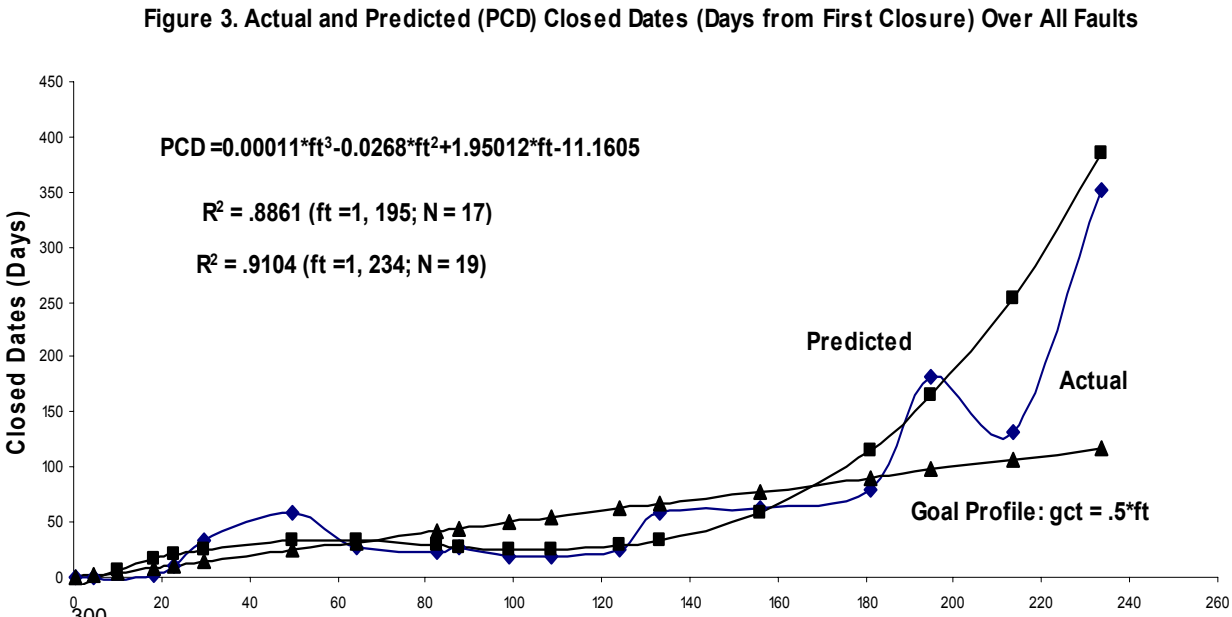


Figure 3. Actual and Predicted (PCD) Closed Dates (Days from First Closure) Over All Faults
PCD =0.00011*ft³-0.0268*ft²+1.95012*ft-11.1605
R² = .8861 (ft =1, 195; N = 17)
R² = .9104 (ft =1, 234; N = 19)
Predicted
Actual
Goal Profile: gct = .5*ft
Closed Dates (Days)

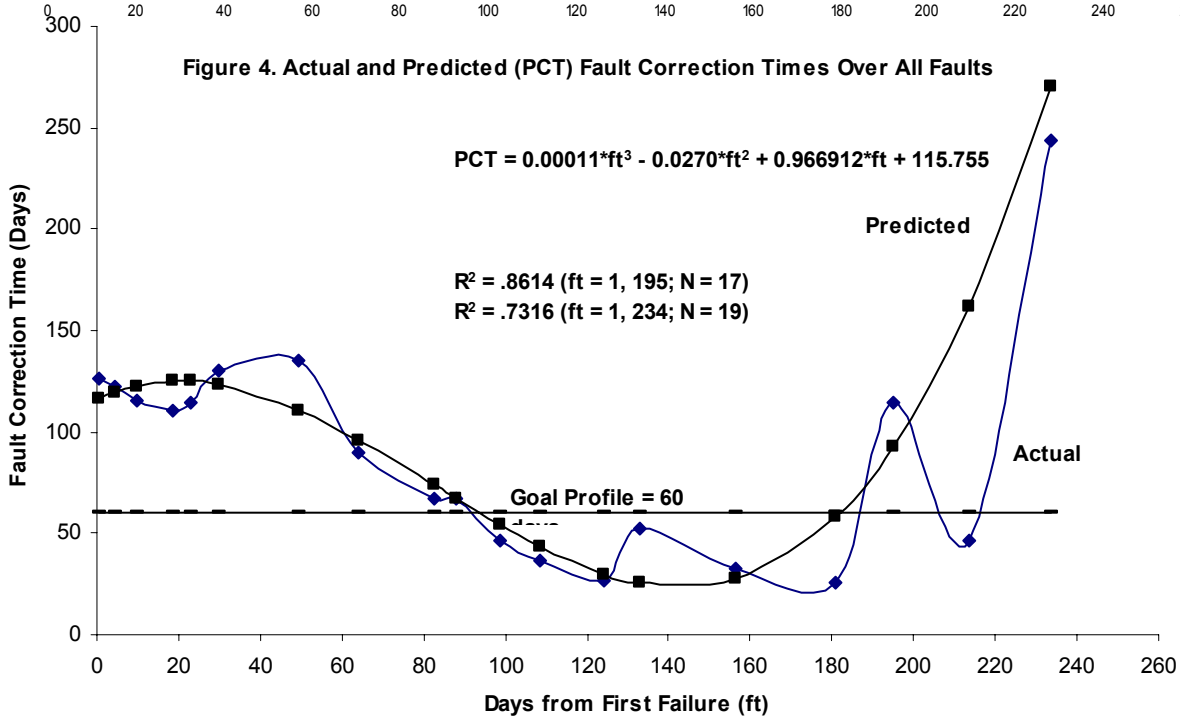


Figure 4. Actual and Predicted (PCT) Fault Correction Times Over All Faults
PCT = 0.00011*ft³ - 0.0270*ft² + 0.966912*ft + 115.755
Predicted
R² = .8614 (ft = 1, 195; N = 17)
R² = .7316 (ft = 1, 234; N = 19)
Actual
Goal Profile = 60
Fault Correction Time (Days)
Days from First Failure (ft)

Figure 5. Deviation of Closed Dates ct (Actual) & PCD (Predicted) from Goal Profile (gct)

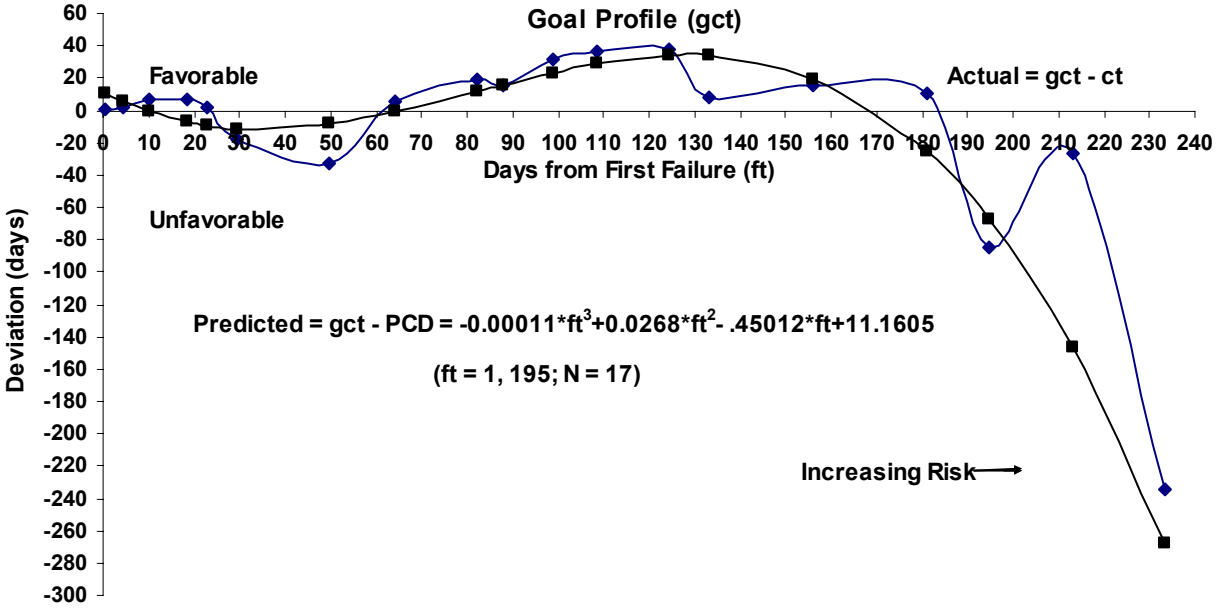


Figure 6. Deviation of Fault Correction Times CT (Actual) & PCT (Predicted) from Goal Profile (GCT)

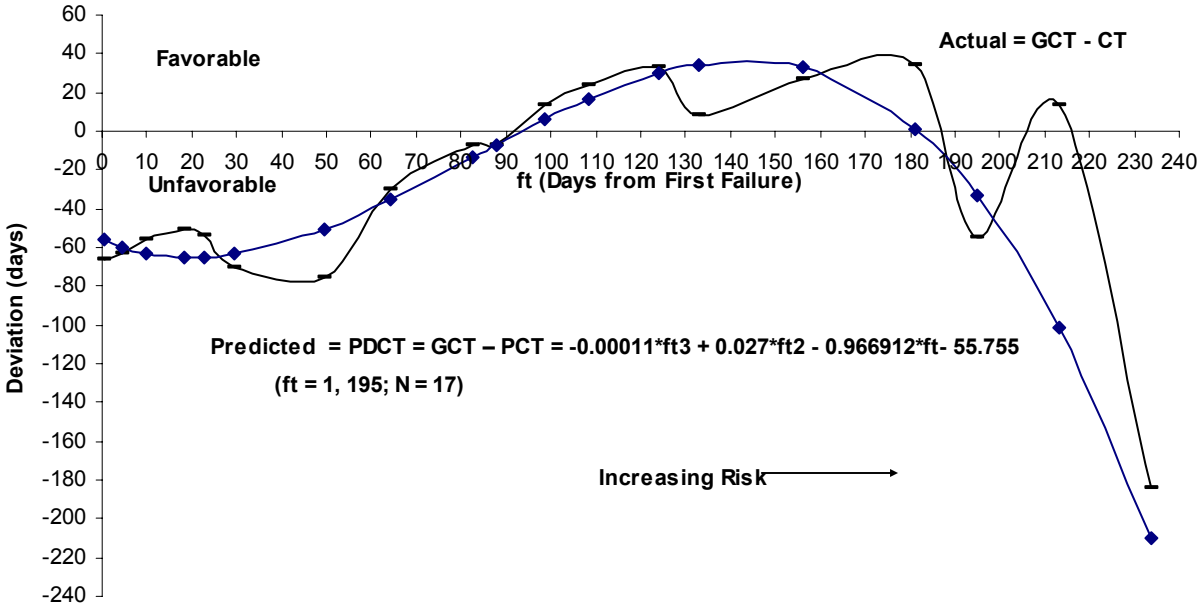
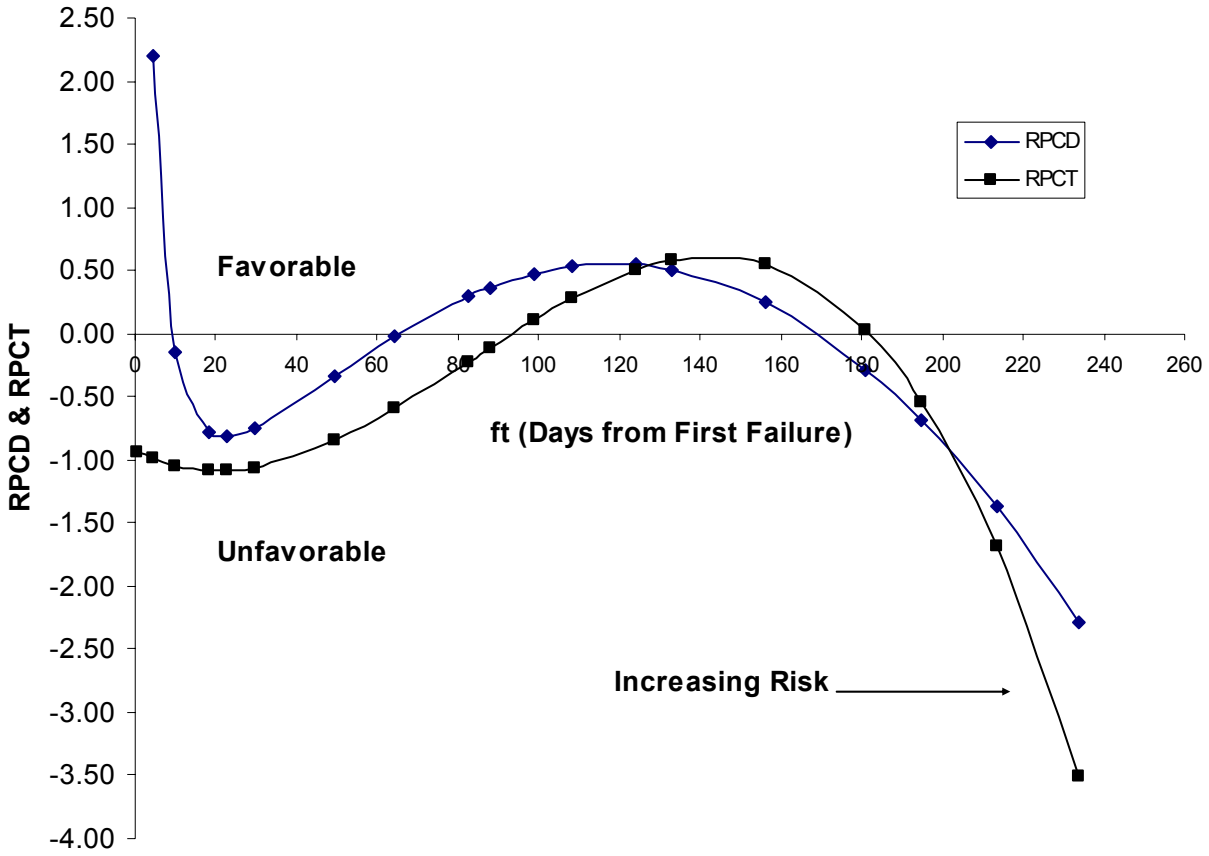


Figure 7. Closed Date Risk (RPCD) & Correction Time Risk (RPCT)



BOOK REVIEW

Title: Reliability Engineering: Theory and Practice, Fourth Edition

Author: Prof. Dr. Alessandro Birolini
E-mail: birolini@emeritus.ethz.ch

Publisher: Springer-Verlag, 2004

Reference: ISBN 3-540-40287-X

Reviewer: Kenneth P. LaSala, Ph.D.
KPL Systems
Silver Spring, MD 20904-3323

Professor Birolini and Springer-Verlag recently have published the fourth edition of the excellent text entitled ***Reliability Engineering: Theory and Practice***. The structure of the book remains basically unchanged from the previous editions:

- Chapter 1 addresses the basic concepts associated with quality and reliability assurance of complex equipment and systems.
- Chapters 2-8 focus on reliability, maintainability, and availability analysis and test, with Chapters 3,5, and 8 focusing on practical aspects. Chapter 2 covers reliability analysis during the design and development phase and covers system structures and redundancies. It also covers reliability allocation (a favorite subject of the reviewer), mechanical reliability, failure mode analysis, and design reviews. Chapter 3 discusses qualification tests for components and assemblies. Included topics that are extremely useful but a bit off the chapter theme are basic component selection criteria such as environment, performance, technology, manufacturing, and reliability. Chapter 4, Maintainability Analysis, has added models and considerations for spare parts provisioning. The chapter also addresses maintenance concepts, design reviews, and predicting maintainability. Chapter 5 addresses many of the non-statistical design considerations such as derating, cooling, electromagnetic compatibility, and testability. Significantly, this chapter now includes design guidelines for software quality that address defect prevention, configuration management, software testing, and software quality growth models. Chapter 6 addresses redundancies and now addresses complex repairable systems in a variety of ways, including imperfect switching, incomplete coverage, and Monte Carlo simulation for rare events. Chapter 7 discusses statistical quality control, reliability tests, maintainability tests, accelerated testing, and goodness-of-fit tests. Chapter 8 covers quality and reliability assurance during the production phase. It includes screening and growth testing, although neither screening nor growth testing (especially the latter) should be restricted to the production phase.
- Appendices A1-A5 address definition, standards, and program plans for the reliability assurance and management of complex systems. This is an important

addition because it helps readers specify and achieve high reliability targets. Appendix A4 is particularly useful because it includes checklists for design reviews. Appendix A5 describes requirements for quality data reporting systems.

- Appendices A6-A8 address basic probability theory, stochastic processes, and statistics. Appendix A7 focuses on basic stochastic process theory and includes Markov, semi-Markov, and semi-regenerative processes. This appendix now includes new models that address non-homogeneous Poisson processes (NHPPs).
- Appendix A9 includes statistical tables, Laplace transforms and probability paper samples.

All in all, Professor Birolini has given readers an excellent instructional tool and desktop reference. It is extremely well written. The span of topics makes the coverage of some topics necessarily brief. Professor Birolini presents much of the non-statistical information in a manner that could be understood easily by engineering and program managers as well as reliability experts. He discusses the statistical topics in the proper amount of detail to ensure at least a good basic understanding. Tables, illustrations, and examples amply support the text. However, one disadvantage for classroom use could be that there are no sets of problems to be worked for homework assignments.

The reviewer thanks the author for the opportunity to review this excellent book and recommends this book highly.

ANNOUNCEMENT

Dr. Norman Schneidewind was selected for an IEEE USA Congressional Fellowship for 2005. In 2005, he will be assigned to work with a congressperson or staff on a variety of public policy issues, including the software reliability of space and DoD mission critical systems and a proposal for a national software certification laboratory to help ensure the reliability of safety critical systems. Only three applicants were selected for this honor.

IEEE Standards Notice

Please note that Process-At-A-Glance has been incorporated into IEEE Standards Development Online per the IEEE-SA News Byte dated 29 April 2004:

Standards developers at the IEEE Standards Association (IEEE-SA) now can access IEEE Standards Development Online to find Process-At-A-Glance information, which includes the rules and procedures for the IEEE standards process. IEEE Standards Development Online consolidates the critical mass of IEEE-SA standards development information into one location and also provides informative training modules for each step in the process. The site covers in detail how to initiate a standards project at the IEEE and how to write a standard. It addresses balloting standards, as well as how standards are published and the various services the IEEE-SA offers standards development groups to help them get their standards out to market. For further details, visit: http://standards.ieee.org/resources/development/index.html

If you should have any questions, please feel free to contact me.

Best regards,

Jodi Haasz
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International Stds Programs and Governance
Standards Activities
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FAX +1 732 875 0695
Email: j.haasz@ieee.org

IEEE Reliability Society
Burlington, VT ADCOM Agenda, July 24, 2004
Third (and last) ADCOM of 2004
Minutes

Adcom Members

TERM EXPIRES 2004 (DEC 31)	TERM EXPIRES 2005 (DEC 31)	TERM EXPIRES 2006 (DEC 31)
Scott B. Abrams Dr. Ann Campbell Dr. Ann Miller Dr. Norm Schneidewind Dr. Christian Hansen Dr. Bill Tonti	Marsha Abramo Loretta Arellano Lon Chase Dave Franklin Dr. Jeffrey Voas Alan Street	Ted Freeman Lou Gullo Dr. Judy Koslov Jim McLinn Eric Snyder Bob Stoddard

Approval of Minutes – Sam Keene

Preview Agenda – J. Voas

Special Presentations – [2 hours]

Matt Loeb, The Institute, (a variety of topics that we need to know about including the new 2004 initiative). The IEEE wants to build interactive learning systems. The initial thrust is to capture knowledge content from the IRPS and from the "Developing Trustworthy Software" workshop. Larry Todd Wilson is the designated knowledge integration consultant working with the Reliability Society to integrate the learning materials. The Reliability Society has been the leading society for the IEEE in educational delivery from live satellite broadcasts, video tapes, CD's, DVD, and now interactive learning. Some points Matt made:

- New RS Web site
- SME experts on Xplore: Larry Wilson and Marilyn Peis (IEEE) are contacts. Cyber Security / Trustworthy SW initiative will follow from Trustworthy Software Workshop
- What is the preferred business model and distribution method?
- How should this initiative be continued in 2005?
- Would there be any room for funding from RS? RS has $30 K set aside for this initiative support
- Would like to tape the DC Workshop for the September 9 and 10, Bill to determine the cost to do this
- If RS needs support from Matt on becoming a council, please request
- Get students hooked on IEEE Xplore they will be hooked forever (Bill)
- All societies are challenged for value / member return
- Can manage your own IEEE web based profile with instant service
- Internet Conference Programs - - on line tele prompt meetings

Could offer a teleconference on "Internet Security", free up to 60 seats

Dick Sacks, IEEE Systems, Man, and Cybernetics Society: spin off from Control Society's 4,000 members with large number of academia's and small entrepreneurs. Entrepreneurial flavor. 2/3 memberships outside CONUS or North America. They have 3 transactions and hold a combined meeting each year for the entire Society including the three specialties. Three points of interest:

1. System and Human - - System Engineering focus, which is the largest part of their interest
2. Cybernetics issued a single transaction to of 2500 pages, special issue, to clean up backlog
3. Their next AdCom will be in the Hague Nederlands on October 10 and a RS representative has been invited. Bill Tonti volunteered to represent RS there.

Bret Michael, Naval Postgraduate School (status of cyber-security initiative) Prototype being developed to deal with cyber intrusion. This will be made available through the IEEE Reliability Society for web delivery and revenue opportunity.

President's report

IEEE Reliability Society Lifetime Achievement and Engineer of the Year Awards updates approved for new support levels.

Approach for Society mergers and Societies combining to form councils is still being encouraged by TAB. We formed a special committee led by Dennis Hoffman to plan for future.

Treasurer's report

Current look at projected '04 expenses / revenue with good surplus because of good 2003 investment returns.

Most recent '05 budget projections -- $2.1 surplus projected for 2005, Hdqts want $21K projected surplus. The society can plan to a $2 or 20K variance in our budget but we remain subject to $100 K swings depending upon our investment success. 2003 was a good year for the markets and good for the IEEE and RS.

IRPS is the biggest conference for RS (bringing in $20K/year and threaten to go away if RS bridges with another with society, diluting the semiconductor emphasis in RS. Members would just stay with EDS and abandon RS. (Bill Tonti)

Display needs to be updated. 2004 money will be used. $3K per display estimated.

VP Publications report -- Christian Hansen (submitted)

C. Hansen and L. Chase attended an on-line training session (conducted by Casey Schwartz) on the use of the new content management system. IEEE at the editors meeting explained that many Transactions are beginning to publish on the web their early versions of accepted papers, before publication. We will soon be ready to do this. We may do so on our own webpage, or through IEEE. Not sure what the charge is through them. Jason strongly recommends that we do this! Many authors express its value.

C. Hansen is serving as interim webmaster until all updates of current content has been completed. Still awaiting either selection of a webmaster with whom Jason can work, or approval to publish our webpage to allow authors to check status on line, submit, and correspond with AE as needed. (VP-Pubs' note: Casey Schwartz from headquarters' IT department will setup Jason with a username to allow him to publish web content using the CMS and she will provide training as needed)

e-Newsletter status – Lon Chase (submitted)

May edition Electronic Newsletter now available through the RS Website.
URL: http://www.ewh.ieee.org/soc/rs/Newsletters/index.html
Next issue expected to be published in August.
Please send Lon your contributions for the August issue.

T-Rel status – W. Kuo

Website complete with help from hdqts; coudos for Christian's support and accomplishments on the web site, from Matt Loeb, IEEE headquarters. Note: Christian Hansen posts our announcements on the web site. The announcements are quality reviewed by Casey Scheartz, who works for Matt Loeb.

As you may know, relevance ratings are out, and ours is down. We have been reluctant to do much directly to affect that, perhaps for good reason in some cases. We should work to improve our relevance where it is good to do so, and we believe the Adcom can help. We prefer to publish more pages (papers) and cut the queue. By the end of the year, we will be processing papers for publication with no queue wait, and very little wait with IEEE. We are about as close as we should be until the new publication charge metrics are in place

Publications on time, but queues are too long. Queue is 12 months from time of acceptance. Rated best of IEEE transactions. Need to encourage IEEE cites, for which we get credit for our rating. 588 pp plus 16 pages of cover for this trans. Queue cut and more cites made of RS Trans. Societies' transactions are rated on the number of times their publication is cited.

- Can increase page count by 20 % in 2005 with no penalty
- Page count has be be –5% to 20%

VP TechOps -- Bill Tonti

- New Warranty committee under Judy Koslov
- New Cyber security assurance committee launched by Brett Michael
- September 9 and 10 seminar planned and advertising SW reliability workshop
    - Washington Post and Baltimore Sun Announcements
    - All other announcements are softcopy, web posting, and email distribution due to the lack of time before the workshop. Announcements have been sent to U of Md, Arizona, NC State, Va. Posted on RS and ASQ web sites, and notice sent out by Software Reliability Engineering Group, as well as Lockheed Martin, Raytheon, Boeing, and DC NASA government contacts, SPIN Colorado, RS mailing list and all software engineers that Sam maintains contact.
- Want to contact Juan bin to participate in Judy's six sigma Warranty committee. Major impact of European Union (EU) on green electronics shipped to Europe and also the elimination of lead from electronic products. This may be another focus initiative like the software workshop. A description of the EU WEEE and ROHS concerns provided in related link.

VP Membership report (Marsha Abramo)

Non-renewing member survey (preliminary results):

- 1995 current active membership (-15%)
- 30 day free trial for IEEE member digital library invitation in October 2004
- IEEE Xplore is providing access availability for RS members this year and next
- Action: Membership Committee to develop plan for recruiting new members, Marsha Abramo, Jim McLinn
- Monthly mailings of Welcome letters to New and Renewing members began in May 04 and will continue.

VP Meetings report (Ann Miller)

Information on Saturday evening dinner – A. Miller

Short Courses on Monday at Vermont University for the Green Mountain Section under Bill Tonti

Seminars in Sept. 04 – Sam Keene, Ann Miller, Jeff Voas, and Thomas Wingfield, international lawyer from the Potomac Institute

Next AdCom in Alexandria Va in association with RAMS

Jr. Past Presidents report (Dennis Hoffman)

ADCOM candidates list has been turned into IEEE headquarters with election results due back by September 17, 2004

- 8 candidates -- pick 6
- AdCom Election for 2005/2006/2007 Term:

    AdCom Candidates running for election:

    - Bob Loomis
    - Bret Michael
    - Sam Keene
    - Ann Miller

- Scott Abrams
- Norm Schneidewind
- Shuichi Fukuda
- Christian Hansen

When Sept 17 results are finalized

- Want to have officers selected before November TAB meeting so the newly elected President can attend with Jeff
- Fellow nominations had to be reviewed on short cycle and the nominations were placed into 3 different categories, with 3 different review committees.

Fellows Report (Dr. Thad Regulinski, Chair):

Three Fellow candidates (all re-submissions) were evaluated under categories indicated:

Dr. Pham - Educator
Dr. Walsh -Technical Leader
Dr. Fukuda - Engineer / Scientist

Evaluations were EXPRESSED MAILED to IEEE in Piscataway for next day delivery on the 17 June and, for redundancy, evaluations were also faxed on the 17th of June. Because three different categories were involved, three different evaluating committees had to be formed.

Sr. Past Presidents report [Ken LaSala submittal]

Ken spoke out on the two initiatives proposed by Dennis:

1. RS withdrawal from the Sensors Council.
2. Appointee Expense Reimbursement Re-instated

The first motion passed by vote of the AdCom. The second motion was deferred. Ken went to the effort to enlarge on these 2 motions, and made the specific request that they be included in the minutes. If the AdCom wishes to re-open this vote in light of Ken's information, then action needs to be taken.

Other Business, Old or New Potential topics

- A Business (and Marketing) committee to be convened by Dick Kowalski. Committee should consider business models.
- Members: Dave Franklin, Marcia Abramo, Jim McLinn, and Bob Stoddard. AdCom suggested that Scott Abrams be approached to join the committee.
- New IEEE initiative possibilities. IEEE seed; then they recoup their funds and split with the sponsoring society any residual returns Need to identify new impact areas that RS could meet (including joint liaison with other societies)
- Other possible areas of joint activities: NSF, Homeland Security

****

Motions

1. Purchase a secondary RS display (Bill, Dennis) passed for a $3K - - passed
   - Include journal pictures from all conferences we sponsor for all displays
   - Marsha will have a committee to define the display posters: Alan, Jim, Lou, Dave (Sam will give a graphic). Bill will ask Tech ops committees to supply graphic. Robert will supply some software graphics
2. Withdraw from Sensors council (Dennis, Lou) -- passed
3. Support our members travel as appointed representatives from RS to the organizations we desire to support - - withdrawn (deferred to next meeting, mainly to get handle on costs)

Action Items:

1. Tonti investigate taping cost for Sept 9 and 10 workshop
2. shopping mall on line shopping mall; add mall feature to our new web site
3. Develop a list of conferences, councils, initiatives that we want to support. Discuss at the upcoming ExCom meeting

Additional Action Items:

1. Alan to coordinate Green Movement (lead free solder) effort to identify technical experts for data capture similar to Bret Michael's cyber-security initiative with IEEE.
2. Alan approach EDFAS leadership about the possibility of creating with EDFAS an IEEE RS backed FA Conference.
3. Jim and Marsha and Lou and Robert to develop initiatives to encourage engineers to join RS.
4. Future thinking committee (business model) to be convened by Dick Kowalski, Frankin, McLinn.
5. Marketing and forward thinking Committee – Kowalski, Franklin, Abramo, Abram, McLinn, Stoddard.
6. Dennis will lead vitality strategy committee. Members will be mainly past presidents with a few AdCom members.

European Union (EU) WEEE and ROHS Initiatives

WEEE Directives
Impact: Two new interrelated EU WEEE directives will severely impact the US high-tech industry. The first proposed directive ("WEEE") regulates the content of electronics, banning use of several essential materials, including lead (used as solder in circuit boards), mercury, cadmium, hexavalent chromium, and halogenated flame-retardants (used in plastics in IT products) by July 1, 2006. The second directive ("ROHS") requires tough targets for using recycled materials; imposes take-back obligations on manufacturers and producers (including take-back for historical wastes); and will result in extensive annual reporting by manufacturers and importers.

Background: In 2001, the 15-nation European Union (EU) Parliament conducted the first reading of two closely related directives on waste from electrical and electronic equipment (WEEE & ROHS; collectively, "the WEEE" initiatives).

1. WEEE
The main objectives of WEEE are:
- *Reduction of waste from electrical and electronic equipment*
- *Increased re-use, recycling and other forms of recovery, thereby contributing to a higher level of environmental protection and resource efficiency*
- *Improved environmental performance of all operators involved in the life cycle of electrical and electronic equipment, particularly those involved in the treatment of WEEE.*

The Directive will cover a wide range of equipment, from household appliances and toys to IT and telecommunications equipment.

Under WEEE, "producers" will have the final responsibility for taking back and recycling electrical and electronic equipment in an environmentally friendly way. The EU believes this will lead to the design and manufacture of products using more environmentally friendly materials. Therefore, the Original Equipment Manufacturer (OEM) -- including importers and resellers (if selling under their own brand) -- will be required to fund the collection, recovery and recycling of the "waste" on a pro-rata basis depending on their sales. Each Member State shall be required to develop and implement a competent system which meets WEEE's requirements.

2. ROHS
The main objective of ROHS is to reduce the environmental impact of WEEE by restricting the use of certain hazardous substances during manufacture. In particular the Directive aims:
- *To ban use of certain substances (lead, mercury, cadmium, hexavalent chromium, flame retardants such as PBB, Penta-BDE) deemed to be hazardous in the electrical and electronic equipment*
- *To exempt medical equipment and monitoring and control equipment from this ban.*

In summary, producers are to be responsible for financing operations for the collection, treatment and recovery / recycling of their own waste and for providing guarantees that future costs will be covered for all WEEE. All costs arising from business-to- business WEEE is to be dealt with by producers, although Member States have the option of making users partly or wholly responsible for these costs.

Both Directives put the emphasis on "the polluter must pay." "The polluter pays principle is laid down in Article 174 of the EC Treaty. The idea behind this principle is to make those persons responsible for environmental pollution that have the possibility to improve the situation. Producers of electrical and electronic equipment design the product, determine its specifications and select its materials. Only producers can develop approaches to the design and manufacture of their products to ensure the longest possible product life and, in the event that it is scrapped, the best methods of recovery and disposal." (Commission of the European Communities 2000/0159).

Dallas Chapter

By Lon Chase, Chapter Chair

Chapter Programs

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

Subject:"Tin Whisker Acceptance Test Requirements"
Date: September 21, 2004
Speakers: Mr. Joe Smetana, Alcatel

Program Summary:
The transition to lead-free has returned an old problem, tin whiskers, to the forefront in electronics assembly. Tin whiskers are a spontaneous columnar or cylindrical filament, which rarely branches, of mono-crystalline tin emanating from the surface of a plating finish. Tin whiskers are a reliability concern. They can cause electrical shorts, disruption of moving parts, and/or degraded RF/High speed performance. In spite of more than five decades of research done on tin whisker growth, a basic understanding of the mechanisms that control whisker growth and prevention remains elusive. Furthermore, both because of this lack of understanding as well as the fact that whisker formation appears to decelerate at temperatures significantly above 60°C, accelerated test conditions and extrapolation models are not yet well established. Pure tin (or other high tin content alloys) are not immune to whisker formation. In spite of the lack of understanding, the industry is moving towards Pb-free electronic devices and assembly. The NEMI Tin Whisker Users Group has developed an acceptance test that is a combination of tin-whisker mitigation practices, process controls and tin whisker testing to reduce the risk problems associated with tin whiskers. This document has been submitted to IPC and to JEDEC to create appropriate industry standards. The presentation will provide an overview of this document and provide the rationale behind the criteria it includes.

About The Speaker:
Joe Smetana is a Principal Engineer, Advanced Technology at Alcatel. He is also a Distinguished Member of the Technical Staff of the Alcatel Technical Academy. He is the technical lead for Alcatel's worldwide lead-free and RoHS activity. Additionally, Joe is chairman of the NEMI Tin Whiskers User Group and is also actively participating in the NEMI Tin Whisker Modeling Project and the NEMI Tin Whisker Accelerated Test Project. Joe also currently chairs the HDPUG (High Density Packaging User Group) Consortium Via Integrity with Lead-Free Processing project and has been very active in various consortium projects involving lead-free assembly and reliability.

Prior to joining Alcatel, Joe served at Texas Instruments as Lead Engineer for Weapons Systems Division Producibility Engineering from 1985 to 1990. He also served as a Nuclear Engineering Officer in the US Navy from 1980 to 1985, primarily working shipyard overhauls of nuclear powered cruisers. He qualified as a

Chief Engineering Officer for Naval Nuclear Power Plants and as a Surface Warfare Officer during this time.

He has a Bachelor of Science degree in Electrical Engineering from Tulane University, as well as graduate studies in Nuclear Engineering with the US Navy. He is a Licensed Professional Engineer in the State of Texas.

Denver Chapter

By Sam Keene, Chapter Chair

Denver Chapter had Prof Chuck Rick make a presentation on left brain problem solving techniques. There were 40 people attending.

The Denver Reliability Chapter supported the Section Conference with three presentations:

1.The Reliability of DC to DC Power Converters: Bill Tian

2. Producing Embedded Flight Software with Agile Commercial and Government Practices: Jon Hagar and Randal Smith

3. Six Sigma Contributions to Reliability: Sam Keene

Japan Chapter

One of important technical meetings at the Japan Chapter is the annual symposium on risk engineering. This year the symposium is held on October 1 at the Tokyo Campus of the University of Tsukuba. The topic of this year is, "Human-machine collaborations in an Emergency." Captain Toshio Tsukahara and Mr. Tetsunobu Nakagawa (First Officer) of the Japan Airlines are going to report their studies on aircraft performance and pilot maneuvers under the circumstances when the traffic alert and collision avoidance system (TCAS) sets off a resolution advisory, such as "Climb, climb, climb!" When a mid air collision is anticipated, TCAS investigates action alternatives and issues a resolution advisory. Although TCAS is basically reliable, it sometimes produces an inappropriate resolution advisory. Thus the resolution advisory is not an order to be obeyed unconditionally. In other words, the pilot may disregard the advisory when he or she is sure that it is wrong. However, that does not mean that resolution advisories of the TCAS are of little use. It is not always easy for human pilots to decide whether to climb or descend when they found a threat aircraft approaching. Such a decision must be made under extreme time pressure with insufficient information for situational recognition. One of my old friends, a retired airline captain, once told me that TCAS saved lives of his passengers and himself. Capt. Tsukahara and his colleagues conducted a field study and simulator investigations to identify how humans can cope with a warning system the reliability of which is high yet not perfect. In the symposium, he and Mr. Nakagawa are going to make their recommendations to airline pilots, aviation researchers and authorities. Engineers and researchers of non-aviation domains, such as automobile, trains, and process plants, are also attending the symposium.

The Japan Chapter started its own Award Program with three categories: (a) Best Paper Award, (b) Outstanding Young Researcher Award, and (c) Reliability Engineering Award. The first winners of the award program were announced in late 2004 February. Mitsuhiro Kimura, Hosei University, won the Best Paper Award with his paper, "A study on software vulnerability assessment modeling and its application to an e-mail distribution software system." Three researchers won the Outstanding Young Researcher Awards: Atsushi Aratake for his achievement in "Optical photonics on IC chipsfor future ultra high-speed O/E packages," Hiroyuki Okamura for his study on "Estimating software reliability in the dynamic capture-recapture method," and Mitsuteru Kokubun for his achievement in "Driving behavior and risk perception of aged drivers on a simulator." Congratulations to all!

Toshiyuki Inagaki, Chair
Japan Chapter
inagaki@risk.tsukuba.ac.jp

Singapore Chapter

By Kin Leong PEY
Chair, IEEE Reliability/CPMT/ED Singapore Chapter

Below are The Singapore Chapter activities for May – Jul 2004.

1. Conferences

- The 2004 International Symposium on the Physical and Failure Analysis of Integrated Circuits (IPFA'04), jointly organized by IEEE ED Taipei Chapter, IEEE Taipei Section, National Chiao Tung University (NCTU) and IEEE Rel/CPMT/ED Singapore Chapter, and technically co-sponsored by the EDS was a great success. More than 70 technical papers were presented, including two Keynote speeches on "Opportunities and challenges for high-k gate dielectrics" by Prof. T. P. Ma of Yale University, USA and "Technology and reliability challenges: A foundry perspective" by Dr. Jack Sun of TSMC, Taiwan. As per the IPFA tradition, four tutorial sessions and an equipment exhibition were held in conjunction with IPFA'04. A special IEEE Transaction on Device Materials and Reliability (TDMR) issue will be published for the selected IPFA'04 papers after going through the standard vigorous peer review.

IPFA'04 banquet. From left to right: Dr. Guido Groeseneken of IMEC, Belgium, Dr. Alastair Trigg of IME, Singapore, Prof. TP Ma of Yale University, USA and Dr. MJ Sai of ITRI, Taiwan.

IPFA'04 at Lakeshore, Hsinchu, Taiwan.

- The organizing committee of IPFA'05 has been formed by the general chair, Dr. Alastair Trigg of the Institute of Microelectronics, Singapore. It will be held in Singapore, 27 – 31 June 2005. The first call for paper was announced at IPFA'04 in Taiwan in July 2004.
- The 6th Electronics Packaging Technology Conference (EPTC 2004) will be held on 8-10 December 2004, Pan Pacific Hotel, Singapore. The call of papers has been announced and the abstract submission has been extended to the end of Jul 2004.

2. Technical Talks

- May 20, Professor Kishor S. Trivedi of Duke University, USA gave a talk on "Reliability modeling: tools & techniques".
- May 27, Dr. Lakshmi Kanta Bera of Institute of Microelectronics, Singapore gave a talk on "Strained-Si MOSFETs and high-K gate dielectrics for advanced CMOS applications".
- July 13, Professor Juin J. Liou (IEEE EDS distinguished lecturer) of University of Central Florida, USA gave a talk on "Characterization and simulation of reliability of MOS devices".
- July 14, Professor Ananth Dodabalapur of University of Texas at Austin, USA gave a talk on "Finding applications for organic transistors".
- July 15, Mr Steve Groothuis of Micron Technology Texas LLC, USA gave a talk on "Advanced CAE simulations in the semiconductor industry".

3. The 4th Workshop and IEEE EDS Mini-colloquium on NAnometer CMOS Technology (WIMNACT-Singapore) was successfully held on July 12, 2004 in Singapore. This mini-colloquium was organized and sponsored by the IEEE Rel/CPMT/ED Singapore Chapter, and co-sponsored by the EDS Distinguished Lecturer (DL) Program and Subcommittee for Regions/Chapters (SRC) as well as the School of Electrical & Electronic Engineering (EEE) at Nanyang Technological University (NTU). There were five invited speakers, including four from overseas and one from the local Chapter. The first talk was given by Prof. Cary Yang from Santa Clara University entitled "Carbon Nanotubes as On-chip Interconnects," followed by the talk on "Trends on Low-Voltage SOI CMOS VLSI Devices and Circuits" given by Prof. James Kuo of National Taiwan University. After lunch, Prof. Juin Liou from University of Central Florida gave the talk on "On-Chip Spiral Inductors for RF Applications: An Overview," followed by the talk on "An Overview of CMOS Technology for RF IC Applications" given by Dr. Yuhua Cheng from Skyworks Solutions. The Workshop ended with the talk by Prof. Xing Zhou on "Technology-Based Predictive Compact Model Development for Next Generation CMOS." In summary, the 4th WIMNACT-Singapore has been another successful event after the 3rd WIMNACT-Singapore, which was organized by the Chapter in October 2003. The Workshop received enthusiastic response with more than 100 attendees from the local industries and academic institutions. They showed deep interests in the invited talks, which covered a wide range of important topics of current and future technologies. The complete information on the 4th WIMNACT-Singapore, including all the slides and snapshots, has been made available from the following website: http://www.ntu.edu.sg/eee/eee6/conf/WIMNACT04.htm.

From right to left: James Kuo (Speaker, National Taiwan University), Kin Leong Pey (Chapter Chair, NTU), Juin Liou (Speaker, University of Central Florida), Meng Hwa Er (Guest-of-Honor, NTU), Cary Yang (Speaker, Santa Clara University), Yuhua Cheng (Speaker, Skyworks Solutions), Chaw Sing Ho (Chapter Committee Member, Chartered Semiconductor Manufacturing), Chee Lip Gan (Chapter Committee Member, NTU), Xing Zhou (Speaker, NTU, Chapter Committee Member)

4. Others

- The Chapter has donated S$1,200 to Temasek Polytechnic for a Bronze Course Medal Award in 2004 and 2005.

Minnesota Reliability Consortium / IEEE Reliability Society 2003/04

Submitted: James McLinn, MRC 2003/04 Chair

"The 10 Most Powerful Reliability Tools"

Speaker: Carl Schmuland of Medtronic, on Tuesday, Feb. 17, 2004. Carl spoke to a group of 32 people on the top ten tools. This meeting was at North Hennepin Community College.

"Handling Dirty Data for DOEs"

Speaker: Mark Anderson, DOE consultant with Stat-Ease on Tuesday, March 16, 2004
Mark presented a presentation on how to handle the all too common but difficult data generated by DOEs. The enthusiastic group of 15 people at the March meeting at North Hennepin Community College enjoyed the topic.

"Electromagnetic Compatibility and Reliability"

Speaker: Dan Hoolihan – EMC consultant on Tuesday, April 20, 2004.
Dan presented a comprehensive presentation on the topic showing how electronic problems can be reliability related. Fifteen people attended the April meeting at North Hennepin Community College.

"Software Reliability with Commercial Off the Shelf Software"

Speaker: Ron Kohl, Software Reliability consultant from Maryland on Tuesday, June 15, 2004
Ron presented a Power Point presentation on common flaws with software and how they impact reliability. Thirteen people attended the June meeting at North Hennepin Community College.

Elections were held at the June Meeting and the following officers elected.

The newly elected officers of the MRC are:

Larry Akre	Chair
Frank Costabilo	Vice Chair
James McLinn	Treasurer
Joe Ward	Steering committee
Andy Anderson	Steering committee
Greg Massey	Steering committee

Submitted July 14, 2004

eFuse Technology

for electronic fuses... aka autonomic chip repair / tune up

Article Summary
eFUSE uses a combination of unique software algorithms and microscopic electrical fuses to help chips regulate and adapt to changing conditions and system demands. e-FUSE-enabled chips are self-monitoring, self-configuring, and self-healing, and can autonomically adjust their circuitry. eFUSE is already in production in our 300mm and 200mm manufacturing facilities.

Breakthrough: Introducing chips that fix themselves
IBM has revealed a breakthrough chip morphing technology, enabling a new class of semiconductor products that can monitor and adjust their functions to improve their quality, performance, and power consumption without human intervention.

The patented technology, called "eFUSE," combines unique software algorithms and microscopic electrical fuses to produce chips that can regulate and adapt their own actions in response to changing conditions and system demands.

By dynamically sensing that a chip needs a "tune-up," eFUSE can alter the configuration and efficiency of circuitry to enhance performance or avoid a potential problem. This autonomic capability is expected to change the way chips are designed, manufactured, and integrated into computers, cell phones, consumer electronics, and other products.

"eFUSE reroutes chip logic, much the way highway traffic patterns can be altered by opening and closing new lanes," said Dr. Bernard Meyerson, IBM Fellow, vice president and chief technologist, IBM Systems and Technology Group. "Our work with innovative technologies like eFUSE is a result of IBM's commitment to investing in fundamental research and development, as well as to creating an environment that values and stimulates innovation."

Chips that repair themselves
eFUSE is part of a built-in self-repair system that constantly monitors a chip's functionality. If an imperfection is detected, this innovative technology "instinctively" initiates corrective actions by tripping inexpensive, simple electrical fuses that are designed into the chip at no additional cost. The activated fuses help the chip control individual circuit speed to manage power consumption and repair unexpected, and potentially costly flaws. If the technology detects that the chip is malfunctioning because individual circuits are running too fast or too slow, it can 'throttle down' these circuits or speed them up by controlling the appropriate local voltage.

The morphing technology also will optimize and tailor the performance and capabilities of a chip to meet an individual customer's product needs in response to changing end-user or software demand. Customers further benefit from the versatility of eFUSE as the morphing can be repeated several times – even after the chip has been packaged and shipped in a product.

An IBM invention
Invented and refined by IBM scientists and engineers, eFUSE achieves a goal pursued by chip designers for many years by putting to positive use the phenomena of "electromigration." This phenomenon has traditionally been detrimental to chip performance and was avoided – even at significant cost and effort. IBM has perfected a technique that harnesses electromigration and uses it to precisely program a fuse without damaging other parts of the chip. Previous implementations of on-chip fuse technology in the industry often involved rupturing fuses, which had resulted in unwanted performance and reliability problems.

Both versatile and adaptable, eFUSE is being implemented to support a variety of applications, such as high-performance microprocessors based on IBM's Power Architecture, including POWER5 and other chips used in IBM eServer systems, as well as low-power IBM silicon germanium chips. eFUSE-enabled chips also are available to IBM foundry customers. eFUSE is technology independent, does not require introduction of new materials, tools or processes, and is in production today at IBM's 300 millimeter facility in East Fishkill, New York, and its 200mm plant in Burlington, Vermont.

As the leading application-specific integrated circuit supplier, IBM is also leveraging the self-managing function of eFUSE in all 90 nanometer chips, including those designed with IBM's advanced embedded DRAM technology. The combination of eFUSE and embedded DRAM helped the company achieve Frost & Sullivan's 2004 Award for Excellence in Technology, which is bestowed in recognition of the development and introduction of an innovative technology that has either impacted or has the potential to impact several market sectors.

Experts on this topic:

Subramanian Iyer, Distinguished Engineer, manager, embedded memory development

Dr. William Tonti, Senior Technical Staff Member, Engineering and Technology Services

Dr. C. Raman Kothandaraman, eFUSE development

Automotive Systems Technology

Dr. Guangbin Yang
Chair of the Automotive Systems technology Reliability

The competition in automotive industry in the past year was more intensive than ever before. To maintain competitiveness, manufacturers of automotive systems have been forced to produce higher reliable vehicles with more features at lower costs. Under the unprecedented pressures, the manufacturers had to develop and utilize more effective and efficient techniques and tools to meet the challenges.

It is reported that a vast majority of field failures can be rooted to design stages. Therefore, reducing design mistakes and improving design robustness are the most significant ways for reducing field failures. A powerful tool for improving robustness is the Design for Six Sigma (DFSS). DFSS is a structured design process, which systematically institutes the existing design tools such as robust design, design of experiment, probabilistic design, and CAE modeling. The process consists of four steps: define system metrics critical to customer satisfaction, characterize the system by decomposing the system metrics into engineering measurable metrics, optimize product / process design, verify the effectiveness of the results. Because DFSS builds reliability and robustness into products at design stage, the technique can reduce design costs, shorten design cycles, reduce field failures and lower warranty costs. Because of the benefits, DFSS has been evaluated, adopted and advanced by automotive industry.

Time to market is an extremely important factor for an automotive manufacturer to maintain or increase market shares. Naturally, testing highly reliable products in shorter time and at lower cost has always been manufacturers' desire, but a challenge as well. As a result, manufacturers and scholars have developed various new testing techniques, for example, the accelerated life tests at higher usage rates. This novel test method allows a product, whose life is measured by usage, e.g., mileage, to be tested at higher stress levels and usage rates. The lifetime at a typical operating point and is extrapolated using the test data. Another example of the new test methods is the accelerated degradation test. Degradation tests stress products at elevated conditions and records degradation of product performance characteristics. Reliability is subsequently estimated by analyzing the measurement data. This method is preferable over the usual accelerated life test because it does not require failures during test. The methods reduce test time and cost, and increase estimation accuracy.

Testing automotive components at real world usage profiles is critical in demonstrating target reliability level. Establishment of real world usage profiles for components or sub-systems is usually difficult. Recently, a research report on component thermal effects discusses a methodology to determine the number of significant thermal cycles and time at temperature a component will experience in design life (say, 10 years) that have dependence upon engine starts.

During product development, statistical tests are not always possible and efficient, especially in early design stage when few prototypes are available. Therefore, qualitative accelerated tests, such as HALT (highly accelerated life test), and (FMVT) failure mode verification

tests, are frequently developed for specific products to serve defined purposes. The failure information yielded in short time provides the direction to design improvements.

Automotive systems are usually expensive; statistical test at large sample size is unaffordable. Motivated by the difficulty, experts have developed various methodologies of using warranty data to analyze failure trends and estimate reliability. The methods are not only economic, but also effective because warranty data reflects a customers' real world usage. There are one-dimensional and two-dimensional methods. One-dimensional methods describe reliability as a function of either time-in-service or mileage, while two-dimensional methods establish reliability as a function of both time-in-service and mileage. The one-dimensional methods are easier to implement, but provide less accurate estimates as compared to two-dimensional methods.

A book, Global Vehicle Reliability - Prediction and Optimization Techniques, edited by J. E. Strutt and P. L. Hall, published by Professional Engineering Publishing in 2003, describes recent progresses in the topics including design for reliability, assessing vehicle reliability using Bayesian networks, reliability improvement through robust design, design verification using customer correlated life modeling, and others.

A special issue of the Quality and Reliability Engineering International, which is dedicated to "Automotive Reliability", co-edited by our committee member, Mr. Julius Wang, has undergone the edition. The issue is to be published in early 2004.

<u>2003 Automotive Systems Committee Achievements:</u>
As the Chair of the Committee newly appointed in January 2003, I sought two highly qualified Committee members. We subsequently developed the committee mission, and submitted it to the webmaster for publishing on the Society's website. The following activity transpired through the year:

1. Participated in Tech Op's conference calls, reporting the Committee's progresses.
2. Held a Committee meeting in June 2003, and discussed the Committee mission, plan of work, tasks, and challenges.
3. Submitted an article to the Society Newsletter for publication.
4. Published papers in RAMS, and submitted papers to the *IEEE Transactions on Reliability* and other journals.
5. Monitored the technical progresses related to the automotive systems.
6. Chaired a session for the 9th ISSAT Conference on Reliability and Quality in Design held Honolulu in August 2003.
7. Established the cooperation with the ISSAT to hold future conferences. The proposal has been approved by the Society's VPs on Meeting and Tech Op. As a result, the 10th ISSAT Conference has published the IEEE Reliability Society as a partner.
8. Our Committee Member, Julius Wang, co-edited a special issue on "Automotive Reliability" for the journal, *Quality and Reliability Engineering International*.
9. Formed and led a Sub-Committee to develop a standard on accelerated life tests in collaboration with the IEC. The Society appointed Sub-Committee may want to develop a standard independently if the IEC does not eventually want to cooperate.

Aerospace & Defense Systems

Lon Chase
Chair of the Aerospace & Defense Systems Reliability

Topics of interest for the Aerospace and Defense Industry are associated with the somewhat unique requirements of the industry. In some cases these are ongoing in areas similar to the past several years. The topics being tracked by the committee include:

1. Use of off-the-shelf (OTS) components and assemblies
2. High mean-time-to-failure (MTBF) requirements
3. Tin whisker growth.

Use of off the shelf (OTS) components and assemblies continues to increase in the aerospace and defense industry. OTS components or assemblies are those unmodified from catalog commercial items and incorporated in aerospace and defense systems requiring high reliability and use in rigorous environments. Although this is not a new topic, the issue continues to develop different aspects. Associated areas of interest include; obsolescence, the hidden costs of OTS, uprating, and a new concern with potential life limited OTS components (wear out mechanisms designed for the commercial market). There are at least two annual conferences dedicated to OTS component and assembly issues; Commercialization of Military & Space Electronics (CMSE) Conference (affiliated with EIA/ECA and IMAPS) held in February and The Military and Aerospace / Avionics COTS Conference (Affiliation with JHU/APL, NSWC and JPL) held in August. Also articles are published magazines such as the COTS Journal available online.

Aerospace and defense systems have increasing reliability requirements. System reliability has historically been demonstrated during its development through testing. Standard testing involves accumulating sufficient operating hours to support demonstration of the required mean-time-to-failure (MTBF) with adequate confidence. This technique requires testing multiple times the MTBF becomes more unfeasible as MTBF requirements increase. Reliability development through Accelerated Life Testing (ALT) is growing; however, no method for correlating system ALT results with predicted reliability has become acceptable. This results in the current dilemma for contracting agencies; how to ensure systems have adequate reliability before they are built. Since testing for demonstration is becoming less of an option, other methods are being explored by government test agencies such as the U.S. Army Evaluation Center (ATEC) and Army Material Systems Analysis Activity (AMSAA). An overall reliability program approach to minimize reliability risk for the procuring customer is gaining initiative. This approach is similar to that outlined in British MOD Def Stan 00-42 (Part 3), R&M Case.

New interest and studies have been initiated in the tin whisker growth mechanism. This phenomenon has been known for years (~60); however, the cause and factors affecting its occurrence are not well understood. Interest has been rekindled because of recent lead free initiatives that are changing component lead plating toward pure tin and because of decreasing component features and voltages. Jay Brusse of QSS Group, Inc @ NASA Goddard reports the following:

a. Tin (and Zinc) whiskers are “hair-like” structures that may grow from mostly pure Tin (or Zinc) finished surfaces,
b. Length up to 10 mm (typically < 1mm),
c. Initiation of growths may occur after many years of dormancy,
d. Growth rate is variable,
e. Whiskers may result in electrical shorts (low voltage / currents), contamination interfering with optics or MEMs, and plasma arcing under certain conditions resulting in catastrophic damage, and
f. The growth mechanism(s) are not well understood.

Although failures are not widespread, they continue to occur and are likely to increase with lead free surface finishes. Studies and communication are continuing among many government agencies and industry to develop characterization models, mitigation strategies, and test/inspection methods. References include Government Electronics Information and Technology Association Engineering Bulletin GEIA-GEB-0002 (Reducing the Risk of Tin Whisker-Induced Failures in Electronic Equipment), GIDEP AAN-U-02-104 (Tin Agency Whisker Action Notice Consortium) and several other industry conference proceedings.

Industrial Systems Reliability

Dr. Hiroshi Yajima
Chair of the Industrial Systems Reliability

The objectives of Industrial Systems committee are to first make reliability issues on site of industrial systems clear, and second to survey the concept and methodology for solving these reliability issues especially useful for real system operation. In 2003, one new committee member has joined and researched a project on the construction of structure of safety study. This project produced a report that outlines the concept and knowledge structure of safety study this year. In the report a first basic concept of safety and necessity of total unification of approaches from various viewpoints such as human, organization, technology, hazard event, environment, and society is explained, and secondly, importance of systems approach is emphasized. Requirements for systems approach on safety study are as follows:

1) Object oriented
2) To pay attention to hierarchical structure of industrial system
3) To attach much importance to relationship between whole system and parts of system. That said, a safety problem is defined not only from the view point of a total system but also from the view point that sub problems of safety should be solved using an interrelationship between the whole system and subsystems.
4) Consideration of whole life cycle of system
5) Safety system should be modified repeatedly by lessons learned and evolutional conception, using finding and facts acquired in process operation, as environment and social value change dynamically.

Additionally this report considers risk based safety, event classification by size and frequency of risk, and risk classification by supposed possibility are introduced, and hazard management for failure prevention and decrease of troubles applying common principle and methodology for each phases of system life cycle is proposed. Also, the report proposes concept and methodology corresponding to actual conditions on real site concerning issues related to safety study and social regime (law, regulation, and standard) and the relationship between safety study and society such as social value, social system for safety, risk recognition and risk communication, social reception of risk.

It is also emphasized that in constructing a concept and technologies concerning reliability issues in industrial systems field, it is necessary to consider issues in the multi level structure, such as industrial field's rebel, social rebel, and life cycle rebel and the concept rebel of system design, technology rebel, failure category rebel and interaction rebel with community.

Members of Industrial Systems committee attended symposium of reliability and system safety. Recently the relation between safety and human error is often explained in the framework of organizational failure. The responsibility of failure does not completely depend on the person concerned. In the symposium, it is pointed out that total behavior of organization including environmental factor systematically leads error potential to failure. Not only imperfection of safety rules and instructions in organization, but also automatic equipments and mechanization of observation operation that are rapidly

introduced recently, new type of information system such as database system and electronic communication system, causes new types of system failure. The symposium was planned to discuss and make explicit issues of new type human error, analysis of the issues, and current status of systematic countermeasure for prevention of failure. Discussion was held in the field of medical treatment, compounding of medication in hospital, aerial navigation, and manufacturing. In the symposium, organizational factor concerning safety is discussed from 6 view point below; (a) Communication, (b) Expert knowledge, (c) Decision of goal priority, (d) Problem identification, (e) Formalization to formal procedure, (f) Role and responsibility. From the medical side, development of an organizational model that is used to systematically analyze and dissolve various type of incidents into organizational factors, and to identify key organizational factors is reported.

2004 IEEE INTERNATIONAL SYMPOSIUM on SOFTWARE RELIABILITY ENGINEERING (ISSRE)

November 2-5, 2004, Saint-Malo, FRANCE
<http://www.issre.org/2004/>

This event includes: Technical paper tracks, Tutorials, Industry best practice presentations, Workshops, and more!
ISSRE focuses on the theory and practice of Software Reliability Engineering. The conference scope includes techniques and practices to (1) verify and validate software, (2) estimate and predict its dependability, and (3) make it more tolerant/robust to faults. Over the years, the conference has grown steadily attracting about 200 participants on a regular basis. The conference is big enough to represent all the key topics in software reliability engineering, but small enough to provide an in-depth representation of theory or practice in these areas. Industry participation has also increased over time, leading to a healthy mixture of theory and practice. This year's theme is on the use of model-driven software development and its implications on software dependability.
ISSRE 2004 will be held in Rennes (Nov. 2) and Saint-Malo (Nov. 3-5). Both towns are medieval cities. Saint-Malo is a corsair (a corsair is a kind of official "pirate," hired by the king) city located on the north coast of Brittany, close to the Mont Saint-Michel and to Rennes. Every street corner, every shore recalls the city's legendary past, along the innumerable walks and seafront promenades. Close to Saint-Malo, the Mont Saint-Michel is one of Brittany's best-known attractions.

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2004 International Integrated Reliability Workshop

Meeting: 2004 IEEE International Integrated Reliability Workshop IRW

Sponsors: Both IEEE Electron Device, and IEEE Reliability Societies

When: Oct. 18-21, 2004

Where: Stanford Sierra Camp, S. Lake Tahoe, California

Purpose: The workshop provides an open forum for presentations, posters, topical discussion groups and focused special interest groups on reliability, technology for all present and future semiconductor applications.

Additional Details at URL: http://www.irps.org/irw/

Keynote Speaker: Tim Forhan, Senior VP Corporate Reliability, AMI Semiconductor
"Managing Tomorrow's Reliability Risks Today"

The Conference is published in the IEEE referenced
"IEEE International Integrated Reliability Workshop Final Report".

Please contact me if you need any additional information.

Joachim Reiner
IRW 2004 Vice Communications Chair
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Product Safety Engineering Society and our 2004 IEEE Product Safety Engineering Symposium

Product Safety Engineering Society

IEEE Announcement:
http://www.theinstitute.ieee.org/portal/index.jsp?pageID=institute_level1_article&TheCat=2202&article=tionline/legacy/inst2003/sep03/9w.newssociety.xml

Note: The Reliability Society is a co-sponser of the PSES

Safety Engineering Society page:
http://www.ieee-pses.org/

Old news letters with good articles:
http://www.ewh.ieee.org/soc/emcs/pstc/psn/

2004 IEEE Product Safety Engineering Symposium

Information about the symposium is available at:
http://www.ieee-pses.org/symposium

Note: IAS is a co-sponsor of the symposium

The call for papers for the Symposium is at:
http://www.ieee-pses.org/symposium/Call4Papers2004.pdf

Jim Bacher

2005 International Conference on Asian Green Electronics - Design for Manufacturability and Reliability (2005AGEC). The conference will be held on March 15-18. The purpose of the conference is to present the latest advancements in environmentally compatible electronics design, manufacturing and packaging technology. The goal is to help electronics companies' design and manufacture green electronics products for the global market.

The conference will cover the following topics:

- Design for green electronics
- Green manufacturing technologies including lead-free solders, conductive adhesives and other green technologies
- Halogen free substrates
- Environmentally Friendly Packaging and Design Technologies
- Life Cycle Analysis and Assessment
- Life Cycle Cost Analysis
- Life Cycle Data Management

You are welcome to visit the website of the conference we have organized in Shenzhen last January for your reference > http://www.ee.cityu.edu.hk/~agec/ . It would be nice if your could let me know the possiblity at an early date.

Angie Wong

Conference Secretary
EPA Centre, City University of Hong Kong

IEEE Election Notice Reminder

This is a reminder that when you publish any information pertaining to the IEEE Annual Election, all efforts should be made to ensure its accuracy. Additionally, if there are plans to publish information on a candidate, please offer the other candidate(s) in that election category the same opportunity. You should either check with Corporate Activities election staff or refer to the election website for the most accurate and up-to-date information on all candidates and election categories.

Contact Fern Katronetsky - f.katronetsky@ieee.org
Contact Angela Wyckoff - a.wyckoff@ieee.org
Check the website: http://www.ieee.org/corporate/elections/candidates.xml

This information should be disseminated to all individuals whom you know to work in the publication of newsletters, magazines, and transactions, etc., that could have an impact on the outcome of the annual election.
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