Reliability & Risk Division
The Global Voice of Quality®

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Check out our website at:
http://www.asqrrd.org/

Reliability & Risk Newsletter
March 2019 Edition

CHAIR'S NOTE

Dan Burrows
Chair, ASQ Reliability & Risk Division
d1c1b1@hotmail.com

Hello ASQ Reliability & Risk Division Members,

I hope that 2019 is going well for you in your professional and personal lives. 2019 is progressing well for the ASQ Reliability & Risk Division as we celebrate 50 years as a division. There has been a little debate about when exactly our 50th year is and it may have actually been 2017. But we don't have a time machine to go back and celebrate and we Reliability and Risk types do like to over-deliver in the time domain – ha! We sponsored a very successful Reliability & Maintainability Symposium (RAMS) at the end of January in Orlando, FL www.rams.org . We had over 90 of our members in attendance and over 30 members presenting and RAMS overall had 600 attendees which was 100 more than we expected . We also provided pre and post symposium courses by Jim Breneman and JD Solomon and had great attendance at those – no wonder since Jim and JD are highly respected and highly sought out gurus of our profession. The next big event on our calendar is WCQI on May 20-22, 2019 in Fort

Worth, TX https://asq.org/conferences/wcqi . We will be hosting a division general meeting on Sunday May 19, 2019 and will welcome people in person and host a web-based meeting.

The really big event for our division coming up is the Reliability, Maintenance, and Managing Risk Conference (RMMR) that we will be hosting as a division on October 15-17, 2019 in San Antonio, TX http://www.asqrd.org/RMMR/ with pre and post conference courses on the day before and the day after the conference. Trevor Craney is driving this effort and he is the absolute best at organizing and arranging successful conferences. We will send out a call for papers soon. We are also calling this our 50th Anniversary Conference – double ha!.
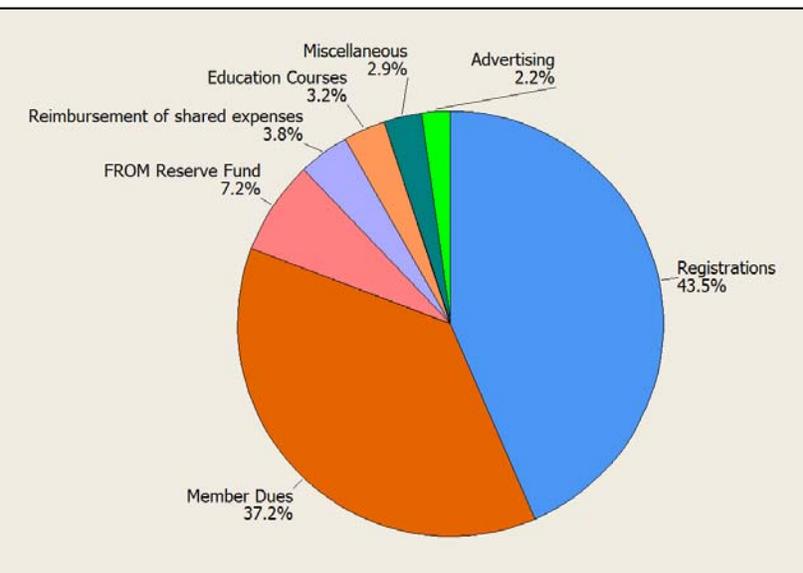
You, the ASQ Reliability & Risk Division members are who we are. The volunteers and member leaders of our division keep the gears turning, so I do encourage you to volunteer in whatever ways you can. Please do send me an email at d1c1b1@hotmail.com to let me know if you would like to volunteer and what aspects you are interested in supporting. For those of you who want to share some of your knowledge and expertise, a good start is to contact David Auda (David.auda@volvo.com) who coordinates our webinars. For those of you who are interested in communications, website, and social media, a good start is to contact Tim Gaens (tim@asqrrd.org).

We do continue to make sure that our division gets the support and resources we need as we go through ASQ Transformation. And every member of our division and ASQ has a voice in this by voting in our division, section, and national elections. In mid-March you should be receiving a ballot for the 2020 ASQ Board of Directors, so be sure to review the candidates, make your choices, and return your ballot.

DIVISION BUDGET REPORT

- Checking account as of December 31, 2018:   **$78,311.65**
- As of December 31, 2018:
  Income over expenses-YTD($64,049.65 - $47,281.13 = $16,768.52
- Other funds/investments :
  - Investing in ASQ(though 10/31/2018): $234.62
    Acct total end of Dec 2017 $32,900.62 withdrawn by ASQ HQ)
  - PNC investment account: $ 0.00
    (Investment account withdrawn by ASQ HQ end of April 2018)

Income by Category (2018)   Expenses by Category (2018)
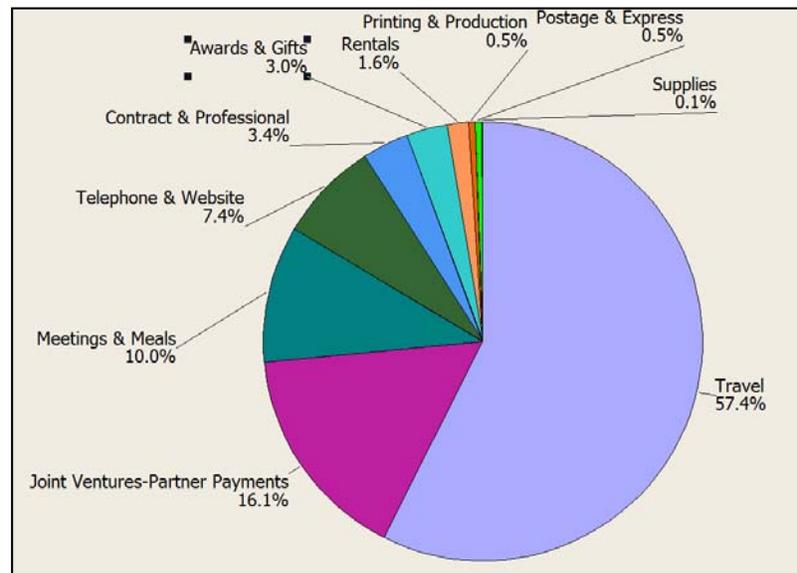
ASQ Reliability & Risk Division Regional Counselor Update

2018 was another outstanding year for our Regional Counselor effort with more than 25 engagements. As ASQ continues to go through ASQ Transformation, the Regional Counselor effort will also go through some transformation. The first transformation is to use the term "counselor" meaning someone who gives advice as an advisor, guide, or mentor instead of the term "councilor". The second transformation will be to realign this effort with the realignment of the ASQ Geographic Communities since ASQ Regions have been realigned and the "borders" changed. Once we understand all of this, we will be renewing our efforts and call for people to serve.

Social Media and Webinar Roundup!!

*Social Media (*Tim Gaens tim@asqrrd.org)

Current follower status on the social media:

LinkedIn: 4,064   Twitter: 607   Facebook: 23

Upcoming Webinars

1. April 11, 2019

Topic: *"What is Reliability?"* Reliabilityweb.com research studies, confirmed by numerous other sources put technical implementation failure for reliability improvements at close to 70%, yet technical methods are proven valid. Why? Join Reliabilityweb.com CEO and Uptime Magazine Publisher Terrence O'Hanlon for a lively interactive presentation and discussion to explore a new context for reliability.

Link to registration: https://attendee.gotowebinar.com/register/7156038785975488780

2. May 9, noon EDT

Topic: *"Understanding Risk to Improve Management Systems"*

BY: Terrence O'Hanlon

The objective of the presentation is to elaborate on the core-concepts and implementation of Risk-Based Decision Making. Additionally, developing a culture of risk based thinking (RBT) is a strategic imperative for an organization pursuing continuous improvement.

Link to registration: https://register.gotowebinar.com/register/9151325834087671042

3. June 13, 2019, Topic: *"Using Case 7,"* Adam Bahret

4. July 11, 2019. Topic: *"SWFMEA,"* Richard Harpster

5. August 8, 2019, Topic: *"How Aging Laws Influence Parametric and Catastrophic Reliability Distributions,"* Alec Feinberg

Calling all Webinar Authors!!
Dave Auda (davidauda@yahoo.com**)**

We would like to extend an invitation on behalf of the ASQ Risk and Reliability Division (ASQRRD). If you would be interested in being a presenter of an ASQRRD webinar, contact Dave Auda. Webinars run every 2nd Thursday of the month at noon EDT for 1 hour,. The content should be something that the attendees can use, Reliability-related knowledge and/or skill.

Why present? A large potential audience that we invite, an additional entry to your resume demonstrating competence, refine your skills, AND earn recertification points.

If you have need of support in developing, preparing and/or presenting at such an event, we can support. Become a recognized subject matter expert!

QE BEST PAPER AWARD – CALL FOR PAPERS!

$1000 Annual Award for Best RELIABILITY Paper!

Quality Engineering is a technical journal of ASQ published by Taylor & Francis. It is directed to professionals in all engineering and management fields interested in quality and reliability improvement.

Continuing with the Reliability & Risk Division's mission to publish more technical papers with reliability topics, we have an ongoing call for reliability and risk related papers to be submitted to Quality Engineering. A special issue on Reliability Engineering has been scheduled for the 3rd issue of 2020 of Quality Engineering. All papers having at least one author as a member of the ASQ Reliability & Risk Division will be considered for our annual best paper award, which carries a $1000 cash award and a plaque presentation at our annual banquet. Submissions should be made through http://mc.manuscriptcentral.com/lqen.

Congratulations to Nathanial Stevens and Christine Anderson-Cook! Their paper entitled "Quantifying Similarity in Reliability Surfaces using the Probability of Agreement", published on the 3rd issue of 2017, has won the 2017-2018 ASQ RRD Best Reliability Paper Award.

For additional information, please contact the ASQ RRD Best Paper Award Chair, Dr. Rong Pan, at rong.pan@asu.edu.

Reliability & Risk support for Social Responsibility

Reliability & Risk has always been concerned with sustainability and social responsibility since what we do reduces risk and makes things last, which is very socially responsible. However, now many organizations, including ASQ, are putting more focus on Social Responsibility as a dedicated effort. We are looking for a member to volunteer to be the ASQ Reliability and Risk Division representative to the ASQ Social Responsibility Technical Community. You would be needed to support a quarterly virtual meeting and related actions. If you are interested, please take a look at:

https://www.linkedin.com/groups/89322

and contact Dan Burrows at d1c1b1@hotmail.com.

Reliability & Risk Division
ASQ — The Global Voice of Quality®

Celebrating 50 Years

October 15-17, 2019
Hilton San Antonio Hill Country
San Antonio, TX

Come join us in celebrating 50 years of the ASQ Reliability & Risk Division!
The conference will feature an extraordinary program, keynote speakers, recognition events, a banquet, and optional pre and post-conference courses. This conference will be an excellent learning experience and a fun event recognizing the efforts of the volunteers who have brought you 50 years of excellence in reliability.

Theme: RMMR – Reliability, Maintenance & Managing Risk – the past 50 years, the next 50 years

Call for Abstracts: See submittal information at website:.

www.asqrd.org/RMMR
Due by: May 31, 2019

Or send your abstract directly to:
RMMR_GC@asqrrd.org
Or Jim McLinn at jmrel2@aol.com

The Annual Reliability and Maintainability Symposium
January 27-30, 2020
Marriott Renaissance Palm Springs Hotel, Palm Springs, California

RAMS® 2020

RAMS® 2020 CALL FOR PAPERS & TUTORIALS

Theme: "R&M in a Model-based System Engineering Environment"

ABSTRACT SUBMISSION DEADLINE — Friday, April 12, 2019

The 66th Annual Reliability & Maintainability Symposium (RAMS®) will be held at the Marriott Renaissance in Palm Springs, CA during the week of January 27-30, 2020. The theme for RAMS® 2020 is "R&M in a Model-based System Engineering Environment". The evolution of autonomous systems, artificial intelligence, new levels of complexity in human-machine interface design, and maintainability decisions have intensified the critical role of RAMS® disciplines. Integrating design elements from concept to final design that replicates actual working environments is the challenge industry faces today. The RAMS® 2020 theme offers a broad umbrella of opportunities for presenting papers and tutorials that address theory and application of RAMS® disciplines in the design, development and support process; and how these disciplines can be applied to new technologies through lessons learned, analyses, modeling, and simulation. Equally important is the discussion on the classical approaches, spanning all technologies, and disciplines focusing on optimizing performance.

With this in mind, we invite you to share the theoretical or practical findings of your research, engineering case studies, success stories, lessons learned, R&M based analyses and simulations, or R&M discoveries at RAMS® 2020 Palm Springs. Tell us how you are designing, optimizing, and supporting systems (both hardware and software) through the execution of RAMS® disciplines.

RAMS® is the premier forum for sharing your experience, knowledge, and roadmaps to success. Make your contribution to the advancement of the RAMS® disciplines and enjoy participating in the rich exchange of ideas and solutions. We want you to contribute your unique experience to our synergistic symposium sponsored by nine professional societies. Start planning to submit your paper or tutorial now.

RAMS® seeks to provide a mix of papers and tutorials. Papers are the best medium to document advances in the state-of-the-art research, and those accepted after being properly peer reviewed will be published in the Conference Proceedings. A short technical presentation with discussion period (approximately half an hour) will be given for each paper at the Symposium. It is the policy of RAMS® to publish all papers presented at RAMS® in IEEE Xplore. Tutorials provide exposure to more fundamental topics. Their technical depth ranges from introductory to advanced. Tutorials are presented in two-hour in-depth sessions at the Symposium. Examples of the most recent written papers and tutorials are available in the 2019 Proceedings and the 2019 Tutorial Notes.

The process for presenting a paper or tutorial at RAMS® 2020 begins with your submission of an abstract. Your submittal should address topics pertinent to Reliability and Maintainability and that are relevant to our theme. The selected topics are listed below:

- Accelerated Life Testing
- Autonomous Systems and AI
- Availability
- Big Data and IoT Applications in R&M
- Business Process Improvement
- Design Optimization Using R&M Techniques
- Discrete Event Modeling & Simulation
- Economic Models for R&M Equipment
- Diagnostics and Prognostics
- FMEA
- Fault Tolerance and Safety Critical Systems
- Fault Tree Analysis
- Human Reliability

- Knowledge Based Training
- Life Data Analysis
- Maintenance Models and Methodologies
- Physical Reliability Models
- Prognostics and Health Management
- Quality Appl. in Electronics Design & Mfg.
- R&M Applications in Aerospace
- R&M Applications in Health Care
- R&M Applications in Infrastructure Management
- R&M Applications in Manufacturing
- R&M Applications in Service
- R&M Applications in Supportability

- R&M and Quality Appl. in Communications Design & Mfg.
- R&M Management
- Reliability Modeling
- Reliability Growth Analysis
- Repairable Systems
- Risk Analysis and Management
- Security and Dependability Analysis
- Software Reliability and Testing
- Software Safety
- System Safety Analysis
- Warranty Data Analysis and Management

If you wish to present a paper or tutorial at RAMS® 2020, now is the time to begin your preparation. To have your paper or tutorial considered for RAMS® 2020, you must first submit an abstract.

The paper submitted must represent your original work and should not be published or presented in any other journals or conferences. Tutorials must address key areas of broad interest in reliability and maintainability engineering.

Abstracts must be submitted via rams.org and the abstract submission process will be available from March 1, 2019, until April 12, 2019.

To submit an abstract for a paper or tutorial, an author must provide the following:

- A title of no more than 80 characters
- An abstract (all text—no equations, figures, or tables) of no more than 1000 words
- Names and contact information for all authors
- An indication of which author will present the paper (if it is accepted for the Symposium)
- Relevant topic areas for their abstract (from the list on the previous page of this Call for Papers)

The names of the author(s) should not be included in either the title or in the abstract.

Authors will also be asked to indicate if any authors are full-time students (to assess qualification for the RAMS® student paper award), and to which (if any) of the nine RAMS® sponsoring societies each author belongs. Membership in a RAMS® sponsoring society is not required for acceptance. Each author can submit no more than four paper abstracts and no more than four tutorial abstracts for consideration. Authors cannot be added to a paper or tutorial after the abstract submission deadline.

The abstract submission procedure for papers and tutorials is the same with the following exceptions: they both use different links to upload the abstracts, each paper can have no more than four authors and each tutorial can have no more than two authors. Upon receipt of your abstract, you will receive a confirmation e-mail from RAMS®. Therefore, it is critical that all authors provide and maintain a valid e-mail address that can accept e-mails. If an author moves or changes addresses, the author must provide their new contact information to the RAMS® Program Committee.

Note that all correspondence regarding papers and tutorials will be sent to the e-mail address of the author who submits the abstract.

Review Procedure for Papers

In May 2019, the RAMS® Program Committee selects a preliminary program of candidate papers and tutorials. Selection of candidate papers is based on innovation, technical merit, clarity, and relevance to the Symposium theme, as demonstrated by the abstract. The status of their abstract will be notified to authors in early June 2019. Authors of candidate papers are required to submit complete drafts of both the paper and presentation slides by the end of July 2019. Draft papers shall be submitted without author identification on the paper in order to accommodate a blind peer review. The specific requirements for papers and presentation slides will be communicated to authors in a timely fashion. Submitted draft of candidate papers will be subjected to review by the Program Committee and RAMS® Editorial Board. The draft candidate papers will also be submitted to IEEE CrossCheck plagiarism detection tool. Authors will be given feedback on their draft papers and presentation slides by the end of August 2019.

Authors of candidate papers must submit their final paper and presentation slides by the end of September 2019. Final papers will be reviewed by both the Program Committee and the RAMS® Proceedings Editor. At this time, authors must also complete a RAMS® Copyright Form, and at least one author of candidate papers must register (at a reduced fee) for the Symposium.

By submitting an abstract for a paper, the author is accepting the condition that a candidate paper may be rejected at any time if the Program Committee determines that the author is failing to comply with RAMS® deadlines or policies, or if the Program Committee determines that the content of the paper is not of sufficient quality to merit publication in the Proceedings. For more information contact the Program Chair at **program2020@rams.org**. The author is accepting the condition that if their paper is ultimately accepted into the Proceedings, at least one author on the paper will register for the Symposium, attend the Symposium, and present the paper at the Symposium in reasonably fluent English.

Review Procedure for Tutorials

The review procedure for tutorials is identical to the review procedure for papers except that they are reviewed only by Tutorial Committee and are not subjected to a blind review.

Authors of accepted tutorials receive gratis registration for Symposium. For more information, contact the Tutorials Chair, at **tutorials@rams.org**.

By *submitting an abstract for a tutorial*, the author is accepting the condition that if their tutorial is ultimately accepted for the Symposium, the author and/or co-author will attend the Symposium and deliver the tutorial at the Symposium in reasonably fluent English.

RELYENCE CORPORATION

Reliability & Quality Software

FMEA · FRACAS · Fault Tree · Reliability Prediction Maintainability · RBD · Weibull

KEY HIGHLIGHTS

- Integrated suite

- Stand-alone tools

- FMEA, FMECA

- FRACAS, CAPA

- Fault Tree

- Reliability Prediction

- Maintainability

- Reliability Block Diagram

- Weibull

- Browser-based

- On-premise or cloud-based

- Online or in-person training

- Implementation services

- Knowledgeable tech support

- Free, no install trial

Relyence offers a complete solution for all your reliability and quality software needs. Along with our software tools, we offer top-notch technical support, implementation services, and training.

The Relyence Solution. Providing seamless integration between FMEA (including Process Flow Diagrams and Control Plans), FRACAS, Fault Tree, Reliability Prediction, Maintainability, RBD, and Weibull analyses, the Relyence tool suite empowers you to effectively manage your products throughout their lifecycle. You can use each module stand-alone, or combine the tools you need in our Relyence Studio integrated platform.

Power & Innovation. Relyence tools offer an impressive list of features. Just a few of the highlights include: customizable cross-module dashboards; user-interface customization; flexible report generation; data importing and exporting; API functionality; device libraries; workflow, approvals, and notifications; user and group roles and permissions; and Relyence innovations such *always-in-sync*™ technology, smart-layout, *Knowledge Bank*™ for lessons learned reusability, and FMEA-Fault Tree *link-sync*™.
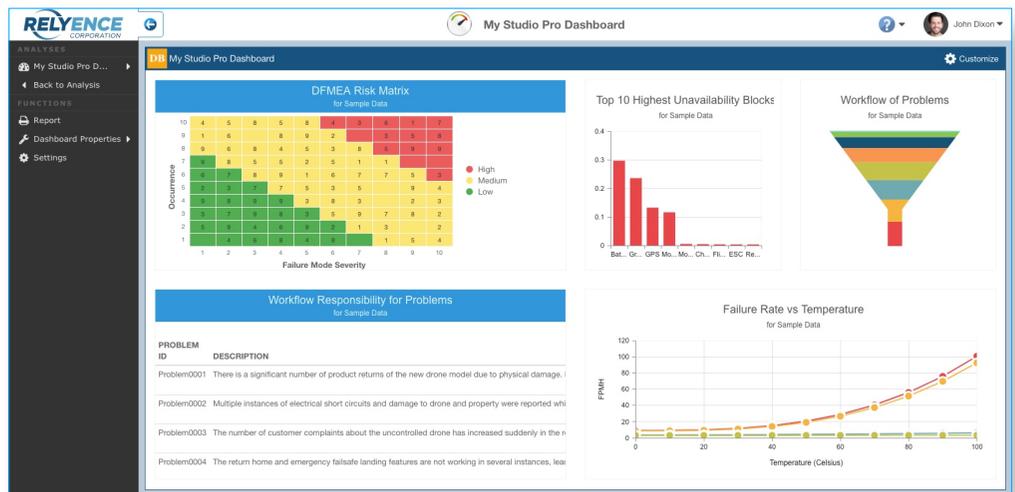
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2018-2019 ASQ-RRD LEADERSHIP POSITIONS

Elected Positions

Chair
Dan Burrows
d1c1b1@hotmail.com

Chair-Elect
Trevor Craney
tacraney@yahoo.com

Secretary
Tim Gaens
tim@asqrrd.org

Financial Consultant
Jim Breneman
weibullman@gmail.com

Past Chair
Dave Auda
davidauda@yahoo.com

Appointed Positions

Membership Chair
Tim Gaens
tim@asqrrd.org

Membership Vice-Chair
Suprasad Amari
suprasad.amari@gmail.com

Nominating Chair
Marc Banghart
marc@asqrrd.org

Education & Arrangements Chair
Trevor Craney
tacraney@yahoo.com

Regional Counsellors Coordinator
Dan Burrows
d1c1b1@hotmail.com

QE Best Paper Award Chair
Rong Pan
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Spanish Host: Norma Antunano (normaantu@aol.com)
Data Analysts: Rachel Stanford (stanford.rachel@gmail.com), Tim Gaens
Video Editor: Ward Baun (wardbaun@gmail.com)

Contact Dan (d1c1b1@hotmail.com) to volunteer with us today!

1. X and Y are discrete random variables. The probability that X = 3 is 0.20 and the probability that Y = 4 is 0.30. The probability of observing that X = 3 and Y = 4 concurrently is closest to:
     a. 0.06.   b. 0.
     c. 0.50   d. Cannot answer with the information provided.

2. The probabilities that three students will earn an A on an exam are 0.20, 0.25, and 0.30, respectively. If each student's performance is independent of that of the other two students, the probability that all three students will earn an A is closest to:
     a   0.0150   b.   0.0075   c.   0.0010   d.   0.7500

3. The following table summarizes the availability of trucks with air bags and bucket seats at a dealership.

	Bucket seats	No Bucket Seats	Total
Air Bags	75	50	125
No Air Bags	35	60	95
Total	110	110	220

What is the probability of randomly selecting a truck with air bags and bucket seats?
     a.. 0.34   b. 0.57   c. 0.28   d. 0.16

4. The lower limit of a normal distribution is:
     a.   negative one.   B.   zero.   C. one.   D.   negative infinity.

5. Approximately 50 percent of all observations for a normally distributed random variable fall in the interval: a. $\mu \pm 2\sigma$ b. $\mu \pm 0.67\sigma$ c. $\mu \pm \sigma$ d. $\mu \pm 3\sigma$

6. A depot receives an average of two engines per day to repair. The probability that they will receive 20 engines in 8 days is:
     a.   3.66%   b. 16.56% c. 6.40% d. 5.59%

7. The approximate 99% confidence interval for the population mean based on a sample of 60 returns with a mean of 7% and a sample standard deviation of 25% is closest to:
     a.   1.546% to 13.454%   b.   0.546% to 13.454% c. -1.59% to 15.589% d.   1.584% to 14.584%

8. What is the computed value of the test statistic that follows an F-distribution when sample variances are equal and the level of significance is 0.10?
     a.   0.90   b. 0.05   c. 1.00   d.   0.10

9 A survey is taken to determine whether the average starting salaries of Reliability engineers is equal to or greater than $59,000 per year. What is the test statistic given a sample of 135 new Reliability engineers with a mean starting salary of $64,000 and a standard deviation of $5,500?
     a.   -0.91   b -10.56   c. 10.56   d.   0.91

10. You have collected monthly returns to depot and want to test the null hypothesis that the standard deviation exceeds the advertised standard deviation of 3.5%. The most appropriate test statistic is based on a:
     a.   chi-square test   b   t-test   c. F-test   d.   z-test

Probabilistic Physics of Failure Approach to Reliability: Modeling, Accelerated Testing, Prognosis and Reliability Assessment

Mohammad Modarres

Mehdi Amiri

Christopher Jackson

2017

This book is the result of the compilation of class notes from several years of teaching a graduate course on accelerated life and damage testing to the graduate students pursuing Master of Science, Master of Engineering and PhD degrees in Reliability Engineering at the University of Maryland. The book provides probabilistic approaches to the physics-of-failure and mechanistic-based reliability prediction and assessment. It relies on various methods and techniques published in the open literature regarding the development and practice of physics-of-failure analysis, accelerated life testing and accelerated degradation testing. The authors discuss the overall concepts, objectives, and framework for accelerated life assessment through the use of formal probabilistic physics-of-failure models. They review important failure mechanisms to demonstrate the process of examining and developing appropriate physics and mechanistic models that describe the degradation and failure phenomena in accompanying accelerated testing and accelerated degradation testing methods, including step-stress testing. The book presents advanced data analysis methods to evaluate the probabilistic physics-of-failure models based on the observed data obtained from accelerated reliability tests and field data. Further, it discusses the steps and methods of probabilistic life assessment and integrity of structures, components, and systems based on the probabilistic physics-of-failure models. This book presents the concepts of life vs. stress and damage vs. time modeling, and describes maximum likelihood estimation (MLE) and Bayesian approaches for parameter estimation, including and step-stress analysis approach and models. In some cases, applications of the introduced physics-based models in reliability engineering and prognosis and health management (PHM) have been discussed.   Readers are exposed to various practical examples and computer-based technique. Since the book is intended for students and more advanced reliability analysts, it provides supplementary solved examples to clarify complex technical topics within each chapter. Although qualitative accelerated tests such as the Highly Accelerated Life Test (HALT) and Environmental Stress Screening (ESS) have been briefly reviewed, the book is mainly about the quantitative methods in probabilistic physics-based and accelerated testing life assessment of structures, components, and systems.

AUTONOMOUS VEHICLE SAFETY: TOMORROW'S REWARDS VERSUS TODAY'S REALITY

Roger L. McCarthy, PhD
McCarthy Engineering

In the 130+ years since Karl Benz put the first gasoline engine his "automobile", no vehicle technology has caused more excitement, comment and speculation than potential vehicle "autonomy" (SAE or NHTSA level 4 & 5). Since the "critical pre-crash event" of ~94% of US traffic accidents is a "driver critical reason(s)," a future where vehicles are driven by fast autonomous agents that do not blink, sleep, drink, etc. has spawned unprecedented safety impact predictions. Autonomous vehicle (AV) potential to revolutionize western economies is inestimable.

The vast tracts of real estate now dedicated to road side parking, driveways, and garages could potentially be reclaimed. The 8% utilization of the average car could increase 10X as they are replaced by autonomous cabs. Total automotive vehicular travel would undoubtedly increase if AV's produced the cost savings projected by some.

Predicting the speed, scale and impact of autonomous vehicle technology is crucial for national transportation planners throughout the world. The potential economic impact of any widely deployed vehicle guidance technology that might be more, or less, forgiving of flaws, changes or inevitable wear and weathering of the roadway must be considered. Increased roadway travel would increasingly burden overloaded highway systems.

Unfortunately, the "hype" surrounding all current US AVs, even though they are using somewhat different technologies, significantly overstates their current capabilities. Even with the foreseeable improvements in the next few years, the AV's ability to operate on normal roads interacting with human
drivers will be limited with little demonstrated ability in snow or rain. The Google self-driving technology requires an "intricate" and detailed map about prospective routes involving "vastly more effort" than Google maps and are "an order of magnitude more complicated."

The early overall crash rates for self-driving prototype vehicles under ideal conditions has been less than promising, even though crashes are virtually always the fault of the other driver. UMTRI observed "the current best estimate is that self-driving vehicles have a higher [emphasis in original] crash rate per million miles traveled than conventional vehicles." In response to the UMTRI study, Google funded a study at the Virginia Tech Transportation Institute (VTTI) which concluded: "the Self-Driving Car operating in autonomous mode when adjusted for crash severity (3.2 per million miles; Level 1 and Level 2 crashes) are lower." The author has updated these studies with his own which still do not provide optimism. The fatal crash rate of Tesla's on "autopilot," ~SAE category 2+ autonomy, appear to be even worse, with a point estimate of more than 40 driver fatalities per million vehicle years compare to 11-13 for the luxury vehicle class. Even the "airbag deployment" rate on Tesla's is higher than that for all conventionally driven vehicles.

Because of these and other challenges, the most significant active accident prevention will likely result from the deployment of automatic "backup" systems that monitor the driver and automatically intervene to prevent crashes.