

QRE CENTER NEWSLETTER

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Quality & Reliability Engineering (QRE) Center

NSF/Industry/University Cooperative Center - Rutgers University & Arizona State University

QRE RESEARCH PROJECTS INITIATED

The Quality and Reliability Engineering (QRE) Center has officially been initiated. A kick-off meeting was held on October 20 and 21 at the Rutgers campus in Piscataway, NJ. The Industry Advisory Board (IAB) for the QRE Center elected Dr. John Twist of Warner-Lambert and Dr. Michael Tortorella of Lucent Technologies as the President and Vice President of the IAB, respectively.

The IAB approved the funding of six research projects. Two other projects are currently on-hold for modifications and changes to make them more useful to member companies. The six approved projects are as follows:

- **System Reliability Models With Uncertain Component Reliability Estimates** - Project Director: Dr. David W. Coit, Rutgers University
- **Multivariate Process Monitoring and Control** - Project Director: Dr. Douglas C. Montgomery, Arizona State University
- **Statistical Methodology for New Product and Process Development** - Project Director: Dr. Douglas C. Montgomery, Arizona State University
- **A General Reliability Model for Accelerated Life Testing** - Project Director: Dr. Elsayed A. Elsayed, Rutgers University
- **Multivariate Control of Batch Processes: Initial Stage** - Project Director: Dr. Susan L. Albin, Rutgers University
- **Electronic Manufacturing Processes and Reliability** - Project Director: Dr. J. Bert Keats, Arizona State University

Work on all approved projects has been initiated. Progress will be reported during the upcoming QRE Center meeting March 23-25 in Phoenix, AZ.

The QRE Center is sponsored by the NSF and operated by Rutgers University and Arizona State University. The center currently has twelve member companies or organizations. The QRE Center is a national resource for research, technology evaluation, development of quality and reliability tools, quality and reliability testing, education, and information transfer.

For more information about the QRE Center or the projects listed here, please contact Dr. Elsayed A. Elsayed at (732) 445-3654

Recent Reliability and Quality Books Authored by QRE Center Personnel

The QRE Center faculty at Rutgers and Arizona State have authored or edited some of the most noteworthy recent books in reliability, quality and related areas. Some examples are:

Reliability Engineering (1996, Addison Wesley) authored by Elsayed A Elsayed, Rutgers University.

Design and Analysis of Experiments (1997, fourth edition, John Wiley & Sons) authored by Douglas C. Montgomery, Arizona State University.

Performance Evaluation of Manufacturing Systems (1997, Springer-Verlag) authored by Tayfur Altiok, Rutgers University.

Software Reliability (1998, Springer-Verlag) authored by Hoang Pham, Rutgers University.

Statistical Applications in Process Control (1996, Marcel Dekker) edited by J. Bert Keats and Douglas C. Montgomery, Arizona State University.

Response Surface Methodology: Process and Product Optimization Using Designed Experiments (1995, John Wiley & Sons) authored by R. H. Myers and Douglas C. Montgomery, Arizona State University.

Computer Automation in Manufacturing (1996, Chapman and Hall) authored by Thomas O. Boucher, Rutgers University.

Next QRE Meeting - March 23-25, 1998

The second QRE meeting will be held on March 23-25. The meeting will be held in Phoenix, AZ. On March 23, Dr. Douglas C. Montgomery of Arizona State University will present the short course, "Some Recent Developments in Statistical Methods for Process Monitoring and Improvement," to QRE Center member companies. Each company can send as many representatives as they wish to attend the course. Dr. Montgomery, author of the most prominent books on experimental design and response surface methodology, has consulted with numerous companies. The meeting will also feature status reports on the research projects.

RAPTOR Reliability Software Tool Available

The Rapid Availability Prototyping for Testing Operational Readiness (RAPTOR) software tool was developed by Headquarters Air Force Operational Test and Evaluation Center, Logistics Studies and Analysis Team (HQ AFOTEC/SAL). Its primary purpose is Reliability, Maintainability & Availability (RM&A) analysis of systems undergoing Operational Test and Evaluation (OT&E). Other applications include test planning, requirements definition, reliability prediction and sensitivity analysis.

RAPTOR allows for quick creation of RM&A models for almost any system. Users model their systems graphically by drawing Reliability Block Diagrams (RBDs) and answering questions about the way components fail and are repaired. These component failure and repair rates can then be simulated to determine RM&A characteristics of the overall system. RAPTOR is a stand alone program which runs under MS Windows.

RAPTOR is available from AFOTEC's website at <http://www.afotec.af.mil/sa/sal/htmlrap2.htm>

QRE Center Activities

- Dr. **Michael Totorella** of Lucent Technologies is the Guest Editor of a special issue of the IIE Transactions on Quality and Reliability. The special issue pertains to the economics of reliability engineering.
- The annual Quality Day was held at Picatinny Arsenal on November 13. The event was organized by **Sid Markowitz** of U. S. Army ARDEC. The all-day event featured lectures by Drs. **David Coit** and **Susan Albin** of Rutgers.
- Dr. **John English**, Associate Professor at the University of Arkansas is spending his sabbatical leave at Rutgers during Spring 1998. He is working with QRE faculty on shift detection when measurements are correlated.
- Drs. **Michael Tortorella** and **Chun Chan** of Lucent Technologies presented a tutorial in January 1998 at the RAMS symposium, Anaheim. The tutorial was titled Design for Reliability: Processes, Techniques, Information Systems. Other QRE participants at RAMS included Drs. **J. Bert Keats** of Arizona State and **John English** who authored conference papers.

Quality & Reliability Papers by Arizona State Faculty

The faculty of the Industrial and Management Systems Engineering Department at Arizona State University have long been leaders in quality and reliability research. 1997 was a particularly fruitful year as evidenced by the number of published papers in the leading technical journals. Examples of 1997 publications are as follows:

1. Lawson, C., Keats, J. B., Montgomery, D. (1997), "Comparison of Robust and Least Squares Regression in Computer-Generated Probability Plots", *IEEE Trans on Reliability*, Vol. 46, No. 1.
2. Montgomery, D., Woodall, W. (1997), "A Discussion on Statistically-Based Process Monitoring and Control", *Journal of Quality Technology*, Vol. 29, No. 2.
3. Prabhu, S., Montgomery, D., Runger, G. (1997), "Economic-Statistical Design of an Adaptive \bar{x} Chart", *International Journal of Production Economics*, Vol. 49.
4. Prabhu, S., G. Runger (1997). "Designing a Multivariate EWMA Control Chart", *Journal of Quality Technology* 29(1).
5. Zimmer, L., N. Hubele (1997), "Quantiles of the Sampling Distribution of C_{pm} " *Quality Engineering*, 10(2).
6. Schaub, D., Montgomery, D. (1997), "Using Experimental Design to Optimize the Stereolithography Process", *Quality Engineering*, Vol. 9, No. 4.
7. Prabhu, S., Runger, G., Montgomery, D. (1997), "Selection of the Subgroup Size and Sampling Interval for a CUSUM Control Chart", *IIE Transactions*, Vol. 29, No. 6.
8. Runger, G., Montgomery, D. (1997), "Multivariate and Univariate Process Control: Geometry and Shift Directions", *Quality and Reliability Engineering International*, Vol. 13, No. 3.
9. Myers, R., Montgomery, D. (1997), "A Tutorial on Generalized Linear Models", *Journal of Quality Technology*, Vol. 29, No. 3.
10. Schaub, D., Chu, K., Montgomery, D., (1997) "Optimizing Stereolithography Throughput", *Journal of Manufacturing Systems*, Vol. 16, No. 4.
11. White, C., Keats, J. B., Stanley, J., (1997), "Poisson CUSUM vs. c-Chart for Defect Data", *Quality Engineering*, 9, 4.
12. Hauck, D., Keats, J. B., (1997) "Robustness of the Exponential SPRT when Weibull Distributed Failures are Transformed Using "Known" Shape Parameters", *Microelectronics and Reliability*, 37, 12.
13. Keats, J. B., Lawrence, F., Wang, F., (1997) "Parameter Estimation of the Weibull Distribution with Censored Data", *Journal of Quality Technology*, 29, 1.

Rutgers IE Department Working Paper Series

The Rutgers University Industrial Engineering Department maintains an active working paper series of technical reports authored by their faculty. Recent quality & reliability papers are as follows.

- 97-102, Economic Complete Inspection Plans with Multi-Decision Alternatives (S. Hong, E. Elsayed)
- 97-103, Design Optimization to Maximize a Lower Percentile of the System Time-to-Failure Distribution (D. Coit, A. Smith)
- 97-104, Software Cost Model with Risk Costs Due to Software Failure (H. Pham, X. Zhang)
- 97-105, System Reliability Confidence Intervals for Complex System Designs with Estimated Component Reliability (D. Coit)
- 97-106, Software Cost Model with Warranty Cost, Error Removal Times and Risk Costs (X. Zhang, H. Pham)
- 97-107, Hierarchical Method for Multiresponse Experiments I: Quantitative and Sensory Panel Data (F. Fogliatto, S. Albin)
- 97-110, Economic Allocation of Subsystem-Level Reliability Growth Testing (D. Coit)
- 97-111, Comparison of Multiresponse Optimization: Sensitivity to Parameter Selection (R. Wurl, S. Albin)
- 97-113, Some Maintenance Models and Availability with Imperfect Maintenance in Production Systems (H. Wang, H. Pham)
- 97-116, On-Line Monitoring When the Process Yields a Linear Profile (L. Kang, S. Albin)
- 97-117, Reliability Estimation Based on Degradation Data (G. Eghbali, E. Elsayed)
- 97-118, Hierarchical Method for Multiresponse Experiments II: Quantitative and Sensory Panel Data (F. Fogliatto, S. Albin)
- 97-119, Evaluation of the Exponential Distribution When Time-to-Failure Data is Missing (D. Coit, K. Dey)
- 97-120, Extended Hazard Regression Model for Accelerated Life Testing (H-J. Shyr, E. Elsayed, J. Luxhoj)
- 97-123, SPC Strategies for k -Step-Ahead Controllers (T. Nugent, M. B-Gursoy)
- 97-125, Mean Estimate for Shewhart-Chart-Monitored Processes with Multi-Class Screening (S. Hong, E. Elsayed, M. Lee)

These reports are available to the public by contacting Ms. Cindy Ielmini at (732) 445-3654.

Calendar of Events

International Reliability Physics Symposium

March 30 - April 2, 1998
Reno, NV

Contact: SAR Associates
301 N. Madison Street, Rome, NY, 13440
Phone: (315) 339-3968
FAX: (315) 336-9134

52nd Meeting of the Society for Machinery Failure Prevention Technology

March 30 - April 2, 1998
Virginia Beach, VA

Contact: MFPT Society
4193 Sudley Road, Haymarket, VA, 21069
Phone: (703) 754-2234
FAX: (703) 754-9743

Institute of Management Sciences & Operations Research (INFORMS) Conference

Montreal, Quebec, Canada
April 26 - April 29, 1998
Contact: INFORMS Montreal
2 Charles St., Suite 300, Providence, RI 02904
Phone: (800) 343-0062

Institute of Environmental Sciences & Technology Annual Technical Meeting

April 26 - May 1, 1998
Phoenix, AZ
Contact: Institute of Environmental Sciences & Technology
940 East Northwest Highway
Mount Prospect, IL, 60056
Phone: (847) 255-1561
FAX: (847) 255-1699

Contributions to Newsletter

For contributions to the newsletter and information, please contact:

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24th Annual Reliability Testing Institute

May 18 - May 22, 1998
Tuscon, AZ
Contact: University of Arizona
1130 N. Mountain Ave., Bldg. 119
Room N517, Tuscon, AZ, 85721-0119
Phone: (520) 621-6120
FAX: (520) 621-8191

4th ISSAT International Conference on Reliability and Quality in Design

August 12-14, 1998
Seattle, WA
Contact: Dr. Ming-Wei Lu
Chrysler Corp., Auburn Hills, MI 48326
Phone: (248) 576-0167

International Conference on Probabilistic Safety Assessment & Management

Sept. 13 - Sept. 17, 1998
New York City, NY
Contact: Dr. R. Bari, Brookhaven National Laboratory
PO Box 5000, Upton, NY, 11973-5000
Phone: (516) 344-5266
FAX: (516) 344-5266

IERC Conference in Banff, Alberta, May 9-10, 1998

The seventh annual Industrial Engineering Research Conference (IERC) will be held May 9 and 10 in Banff, Alberta, Canada. The conference is sponsored by the Institute of Industrial Engineers (IIE). There will be eight sessions at the conference dedicated to quality and reliability research. The QRE Center will be well represented at the conference. Specifically, Drs. E. A. Elsayed, Hoang Pham and Mohsen Jafari of Rutgers will be session chairmen. Papers will be presented by many QRE Center representatives including Drs. David Coit, Susan Albin and James Luxhoj of Rutgers. Also, Hossein Eghbali and Xuemei Zhang, Ph.D students at Rutgers are co-authors of technical papers.

For information, call the IIE at (800) 494-0460.