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Practical Reliability Engineering for Industry by Dr. Alec Feinberg

DATES: May 10-11, 16-17, 2017 You must participate in all 4 days
TIME: 8:30 am to noon Pacific time (California)
COST: $850 per person for 4 days Group discounts available!

Register now!
https://attendee.gotowebinar.com/register/7613933685579102211

This is an intense, practical course for industry focusing on applying reliability in real world situations. It uses a stage gate approach to reliability as product transition from the Idea Phase, Evaluate, Develop, Transition and lastly to the Production Stage. This is a 14 hour webinar, which costs $850, (broken down into 4 half days) and includes course material and reliability software (30-day trial) to accelerate learning. The material provides depth and exposure to the industry's reliability science.

We start with basic methods in reliability & quality, providing full explanation of how to grow reliability in a commercial environment and translate that into ROI dollars. Reliability growth starts in the Design Idea phase using tools like FMEA, reliability predictions, and reverse engineering. Here we provide a formal method for providing a detailed reliability plan for the product. We describe how to develop the plan with management and engineers so that everyone is involved and sample sizes and cost are obtained up front. We move into Evaluation stage gate demonstrating and analyzing reliability in the testing phase with prototypes. We describe how to organize an effective DART (Design Assessment Reliability Testing) plan that includes HALT. We detail the method of test design by failure modes. As the product matures and the design becomes frozen, we move into the Development stage gate where we often do Design Maturity Testing demonstrating reliability with qualification testing. We go over the common specification and describe how to design test with and without specifications. Reliability statistical analysis is key and is accessible to the student through our professional DfRSoft software tool. Each student has the software to follow along during the course to help problem solving quickly. This jump starts ones capability. We then move into the Transition stage gate. Here we are concerned with production screening such as HASS. Finally we move into production monitoring where we monitor reliability with a sampling strategy.

Test methods such as temperature, temperature cycle, humidity, shock and vibration and how to analyze your test using this software, for both physics and statistics problems are demonstrated for all accelerated testing, with clear exercises. The concept of test design by failure modes is presented. Examples are given. All the key accelerated test models (Arrhenius, Humidity, Thermal Cycle, Electromigration) are provided and illustrated. Both simple and advanced reliability math is overviewed and taught efficiently with software examples. The concept of design maturity testing using accelerated test methods and Chi-squared test planning and analysis, again with software exercises, are used to assess products failure rate/MTTF. We include Quality tools such as Cpk, lot sampling, sparing, availability and normality analysis. We also describe methods to analyze field return data to derive an MTBF. As part of reliability analysis, we present special topics tailored to the classes needs. This includes Physics of Failure, what equipment to use and when (SEM, Auger, X-RAY, XRF, Focused Ion Beam) etc. Numerous failure analysis pictures are shown to see first-hand the challenging failure modes and how their mechanisms are identified using such equipment. Other topics include a strong overview in understanding in Shock and Vibration, Advanced ESD methods, RoHS challenges, and parametric reliability analysis.

PART 1: BASIC METHODS IN RELIABILITY & QUALITY

1. Reliability & Quality in Today's Marketplace
   - A Practical Approach to Reliability Implementation
   - Reliability Growth and ROI
   - Reliability as a Differentiator
   - **The Main Components of a DfRQ Company Program**

2. The Stage Gate Approach
- ○ Idea, Evaluate, Development, Transition, Production
- ○ Understanding Each Gate - The Tools for your Program
- ○ Piecing it Together - A Value Added Reliability Program

3. Basic Reliability Mathematics (Using DfRSoft Tools)
- ○ MTBF/Failure Rate Basics
- ○ Failure Rate Conversion (FITs, FMH, MTBF, PPM, AFR, %Failure)
- ○ System Reliability Analysis & Block Diagrams (Series, Parallel, Redundancy for K of N, Active/Standbys)
- ○ Reliability Predictions (Parts Count, Detailed Stress, Telcordia, Mil Std 217…)

4. Basic Quality Test Engineering (Using DfRSoft Tools)
- ○ Cpk, Yield, Normal/Lognormal, & Six Sigma Analysis
- ○ SPC Charts
- ○ Visual Inspection/Design Release

PART 2: DEMONSTRATING & ANALYZING RELIABILITY
IDEA – STAGE GATE

5. Top Down FMEA for Reliability Program Planning
- ○ What is a Top Down FMEA
- ○ Top Down FMEA for Program Planning
- ○ Team Approach
- ○ Design Controls & Recommended Actions
- ○ How to Make a Program Plan with Top Down Example
- ○ Value of Derating (Derating Specs - DfRSoft Guideline)

5a Bottoms Up Design FMEA
- ○ Key to a Good DFMEA
- ○ Most Efficient DFMEA

EVALUATION – STAGE GATE

6 . Design Assessment Reliability Testing & Reliability Growth (DART - HALT) (DfRSoft Tools)
- ○ Finding Failure Modes – Test to Fail Not to Pass
- ○ Accelerated Reliability Growth
- ○ Test Design by Failure Modes
- ○ HALT
- ○ Design Margin – Load-Stress Reliability Interference Assessment
- ○ Electrical Derating DEVELOP - STAGE GATE

7. Advanced Reliability Mathematics (Using DfRSoft Tools)
- ○ Time Dependent Failure Rate
- ○ Main Distribution of the Bathtub Curve, Weibull, Exponential, and Lognormal
- ○ Introduction to Reliability Plotting Using Software

8. Accelerated Life Models & Environmental Profiling
- ○ Acceleration Factors & Models (Temperature-Arrhenius, Coffin-Manson Temperature Cycle, Vibration Accelerated Models)
- ○ Chi-squared confidence method for accelerated testing
- ○ Environmental Profiling (model for environments with varying stress profiles)

9. Design Maturity Chi-Squared Demonstration Testing (Using DfRSoft Tools)
- ○ Testing for a Reliability Failure Rate Objective?
- ○ Accelerated Test Plan Examples
- ○ Statistical Confidence Test Plans

RELIABILITY MONITORING & SCREENING STAGE GATES

10. Reliability Monitoring and Screening
    - ○ Screening vs. Monitoring
    - ○ Common Screens and Monitoring Tests
    - ○ HASS Screening

11. Field Returns and Device Hours (DfRSoft Tools)
    - ○ Device Hours – Multiple Test Uses and Field Returns
    - ○ AFR – Most common company metric
    - ○ Field Return– Raw Data Analysis

12. Availability & Sparing (DfRSoft Tools)

PART 3: SPECIAL TOPICS TAYLORED TO THE CLASS' NEEDS

13. Advanced CDM ESD Concepts
    - ○ Introduction CDM compared to HBM
    - ○ Why Ionizers can be important
    - ○ ESD versus EOS damage
    - ○ CDM Case Studies
    - ○ Advanced Audits/Investigation, Test Fixtures

14. Shock & Vibration (Numerous Exercises)
    - ○ Understanding Gs & gs
    - ○ Vibration testing for Shipping

15. Physics of Failure 7 Step Problem Solving

16. Physics of Failure Analysis Tools Detail Analysis Pictures Showing Strengths of Instruments
    - ○ SEM (FE-SEM, EDS)
    - ○ Digital Microscopy
    - ○ Real Time Radiology, X-Ray Maps
    - ○ Thermal Imaging
    - ○ FTIR

17. Physics of Failure (Numerous FA Pictures, Industry Lessons Learned and Design Rules to Avoid Issues)
    - ○ Four main types of aging
    - ○ Diffusion - Substitutional, Kirkendall
    - ○ Intermetallics - Au Embrittlement, Purple Plague
    - ○ Bond wire failures - non stick, intermetallic
    - ○ ○ Dendritic Growth, Ag Migration & Electromigration
    - ○ CTE's Mismatch, Thermal Fatigue
    - ○ Engelmaier IPC Solder Joint Life Model, BGAs
    - ○ Electronic Failure modes from shock, vibration
    - ○ Creep, Solder Creep, Creep Resistance in Plastics
    - ○ Organic contamination
    - ○ Popcorn Cracking, Voiding Delamination
    - ○ Assembly Errors
    - ○ Solder Failures (non wetting, grain size, leaching, coverage)
    - ○ Contamination – Solder non-wetting, Epoxy non-stick
    - ○ Plating Contamination
    - ○ RoHS Lead Free Solder Issues
    - ○ Cu Dissolution
    - ○ PCB Finishes
    - ○ ESD & EOS - Dielectric Breakdown
    - ○ Current Density & Fusing of Bond wires and wires
    - ○ Junction Temperature Issues & Modeling

18. Putting it all Together

19. Homework (optional) includes the Solution Set

Dr. Alec Feinberg is the founder of DfRSoft. He has a Ph.D. in Physics and is the principal author of the book, Design for Reliability written at M/A-COM. Written in an industrial environment, it is a very practical book and has a very extensive approach to the DfR process using a stage gate process since products are developed in phases. Alec is also the principal developer for DfRSoftware which is the most thorough reliability tool currently available and is also used to accelerate learning in his classes. Alec's industrial experience has allowed him to provide extensive reliability engineering services in all areas and on numerous products in diverse industries (AT&T Bell Labs, TASC, M/A-COM, Tyco Electronics, and Advanced Energy) for over 35 years that include solar, thin film power electronics, defense, microelectronics, aerospace, wireless electronics, and automotive electrical systems. He has provided training classes in Design for Reliability & Quality, Shock and Vibration, HALT, Reliability Growth, Electrostatic Discharge, Dielectric Breakdown, DFMEA and Thermodynamic Reliability Engineering. Some of the well-known companies that have taken his courses include Hewlett-Packard, Sandia National Labs, Canadian Space Agency, Sierra Wireless, Mentor Graphics, Woodward Industrial Controls, Tyco Electronics, and Northrop Grumman. Alec has presented numerous technical papers and won the 2003 RAMS Alan O. Plait best tutorial award for the topic, "Thermodynamic Reliability Engineering." Alec has a new book, *Thermodynamic Degradation Science: Physics of Failure, Accelerated Testing, Fatigue, and Reliability Applications* (due out October 2016, with the publisher John Wiley & Sons). Alec's main hobby is jazz harmonica.

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View System Requirements