

Design for Reliability

Comprehensive, Progressive and Practical Training and Development Solutions Customized for your Organization

Venue • Location to be Announced

| Date: scheduled based on request |



Applications of the Most Advanced and Effective Design Analysis and the Most Utilized Methods in the Product Reliability Design Assessment Toolkit

In today's highly competitive and cost conscious environment, companies are making it critical to embrace power in incorporating reliability into the design process and robust product design as a means for driving higher levels of availability, optimize product performance and reduce warranty cost.

ARE YOU VALIDATING YOUR ENGINEERING DESIGN TO MAKE YOUR PRODUCT ROBUST?

THIS THREE DAYS INAUGURAL RELIABILITY BASED-DESIGN ASSESSMENT SEMINAR IS FOCUSES ON:

- Statistical methods to achieve high reliability and availability and optimize product performance through **strategic application of scientific quantitative techniques**.
- Presenting methodologies that clearly explains how to design for **zero failure of critical system functions**, leading to substantial savings in the product life cycle cost and improvement in ability to compete in markets.
- Delivering **proven strategies** to successfully incorporate and operate **reliability driven design** programs in complex systems.
- Demonstrating how **reliability analysis techniques** are applied to model and analyze reliability data and facilitate product design decisions.
- **Benchmarking** your traditional reliability programs against **the latest strategies** in engineering design reliability assessment.
- Demonstrating how high failure rates and warranty costs associated with systems that are poorly designed for reliability applies to the overall cost of unreliability and how this **impacts profitability**.

AVAILABLE AS ONSITE COURSE



LebenTech® Innovative Solutions, Inc.



WORKSHOP INFO.

Is your company ready to?

Adapt | Implement | Improve

Today's engineering managers face increasing pressure from employers, customers and regulators to develop reliable and robust products that are less prone to failure and that are safe and efficient. An understanding of reliability methods and maintenance planning can help accomplish these conflicting goals.

Without adequate product reliability planning, even the most efficient and seemingly cost-effective system designs can incur enormous expenses due to repeated or catastrophic failure and subsequent search for cause.

This three days, comprehensive, hands-on seminar, designed for both the new and seasoned practitioner, provides you with all the tools you need to help initiate your design and reliability assessment. Learn about the development and use of world class design reliability techniques and applications for improving system availability in your company.

This course provides a comprehensive review of the various aspects of product reliability performance for systems designed for the **automotive, household appliance, electronics, medical device, military, and communication**, industries. Principal emphasis is placed on the primary means of achieving system reliability, which is the prevention of critical equipment failures, particularly, any which could cause significant consequences.

It builds on a **focused and practical coverage** of reliability engineering methods and selection and provides structured procedures and applicable calculation formula and methods for the system reliability. It also underscores the importance of interactions and cooperation between the three key functions of reliability engineering, product operation and design engineering in achieving the optimum reliability and availability level in the product performance. It enforces this key issue with practical examples of significant failures resulting from lack of understanding of the roles, responsibilities and interfaces between these functions.

With an accessible blend of mathematical rigor **and simplicity**, this course is the ideal workshop for novice and expert engineers seeking to increase performance and longevity of their company's products, for the analysis and verification of system reliability and for maintenance planning.

Course Objectives

The key general objectives of this course are as follows:

- Provide assistance to participants in developing understanding and applying the various aspects of reliability engineering techniques to ensure system efficiency in a responsible and cost-effective manner.
- Provide the means for enhancing the knowledge and skills of the participants in system reliability evaluation and analysis; and the selection of critical functions for risk assessment.
- Provides participants with the latest practical, effective methods and engineering tools required to perform design reliability analyses.
- Provide comprehensive details of the fundamentals and specific techniques underlying the assessment of system reliability, detection and diagnosis of faults, and best practices for cost-effective reliability improvement.
- Gain an appreciation of the importance of reliability to product development or system success. They will develop an understanding of the practices that are appropriate to apply for different functional situations as well as the basis of implementing the practices cost effectively.
- Develop and enhance their understanding of the tools and techniques for developing optimistic reliability models of complex systems while utilizing inspection or failure data and information to estimate the parameters of such models.
- Develop knowledge of how to apply a more effective reliability program when their company does not have enough time, resources or money to analyze all company's products.
- Systematically apply the design for reliability methods to software development to achieve rapid results when implementing reliability strategy.

Training Methodology

This course combines sound engineering design and reliability engineering concepts, principles, methods, the best industry practices and practical solutions. It offers comprehensive coverage of basic statistical and various methods of analysis. It presents both parametric and non-parametric statistical methods to allow selection of the most useful methods for analyzing a given set of data.

It places all models in context and demonstrates the mathematical principles and trade-offs between accuracy and experience. Actual industry case studies as well as organization's experience will be reviewed in depth to reinforce every topic.

The course also comprises of lectures, and interactive exercises to maximize participant's benefits. Additionally, an optional "Question and Answer" period is included to provide participant with opportunity to get expert answers on their specific questions.



Product Design for Reliability.

Who should participate in this training?

This course is particularly valuable as a must-have guide for managers and engineers, in Research and Development, Product Development, Reliability Engineering, Quality Assurance and Product Safety, as well as anyone who have responsibilities to deliver high performance at a lower cost while minimizing system failure.

Organizational Impact

- The company will be able to achieve measurable improvement in product reliability, maintenance efficiency and effectiveness by identifying, adopting and implementing new design reliability assessment methods recommended by delegates.
- The company will be able to use risk assessment methodologies to quantify and prioritize risks, and to allocate resources for optimum benefits.
- The organization will be able to enhance its ability to utilize statistical methodologies resulting in lower life cycle costs while complying with quality, safety and performance or regulatory requirements.
- The company is able to enhance organization profitability by adopting and applying industry proven reliability techniques and methods.
- The company will be able to reduce potential warranty cost of their products launched in the field by employing a pre-emptive approach.

Competencies Emphasized

- Product designed for reliability capabilities in accordance with the latest world class techniques and approaches to develop a holistic reliability program.
- Statistical methods and selection criteria for specific reliability assessment to improve product design.
- The identification and assessment of system degradation mechanisms and the failures they may cause.
- Hazard identification, risk analysis and effective reliability management.
- Application of reliability testing methodologies in the verification, and quantification of system reliability.
- Utilizing reliability design considerations in the development of reliable software.

R&D Engineers: Shall be exposed to new tools for understanding how reliability applications and effective engineering design principles can improve availability of their system. They will learn how to influence improvement in product robustness, how they can assist in reducing product failures.

Reliability Test Engineers: will be able to identify and apply new and proven reliability testing techniques for verifying and quantifying product reliability. They will also learn how Design of Experiment can be applied as a means to make the product more robust.

Engineering Managers: will find the business aspect of reliability applications helpful for measuring improvement in product design, system operation, and to reduce cost of unreliability associated with system availability.

Quality Engineers: They will learn how reliability tools and techniques can be helpful for understanding failure data in systems that failed in the field, and how failure data and warranty cost is used to justify making equipment more reliable as a business decision.

Design Engineers: They will learn how to influence reliability improvements in design, how they can assist in reducing design failures, and learn how they can calculate the cost of unreliability for making business decisions to attack problems of unreliability.



Prerequisite

1. Two or more years of engineering experience.
2. Basic understanding of product design analysis.
3. Basic understanding of probability and statistics.
4. Basic knowledge of product development testing strategies.



LEARNING OBJECTIVES

Personal impact after completion of training:

- Participants will enhance their knowledge and expertise in software reliability and maintainability strategy, and will be equipped with structured procedures and effective guidelines to perform design analysis and validation of software quality characteristics.
- Participant will gain a sound working knowledge of the interdependence of risk, design risk assessment methods, risk mitigation techniques and the standards or regulation products are required to be in compliance with.
- Participant will extend his or her knowledge of reliability engineering to medical device, automotive system, communication systems, household appliance, military vehicles, risk analysis, statistical methods applications in reliability performance, and optimization methods applied to support product design decisions.
- Participants will enhance their ability and skills in product design for reliability techniques, failure detection and analysis, estimating failure consequences, and fitness for service assessment.
- Participants will enhance their core competencies and productivity thereby improves their particular strengths and performance levels as well as making additional value added contributions to their organizations.
- Participant will gain a working knowledge of the techniques of reliability engineering and the ability to apply them effectively in improving the maintenance strategies, maintainability design features, product robustness and reliability performance.
- Participants will enhance their understanding of the general principles and practice of product reliability assessment and of reliability testing, how to interpret failure data and symptoms, and how to diagnose associated faults.
- Participant will be able to explain where and when they should invest company's resources to maximize the potential of product reliability improvements as well as developing a solid plan for action for strategy implementation.

From reliability assessment
To improved product design
And robust functionality!

Expand your knowledge with this essential seminar
specially created for your technical development.



MEDICAL DEVICE



AUTOMOTIVE



PRINTING SYSTEM

Improve Product Reliability [30% - 45%], Reduce Risk, Vulnerability, & Warranty Cost [15% - 35%]

DAY 1 - Schedule Based on Seminar Date

8:30 - Registration & Morning Coffee

9:00 - Chairman's Opening Remarks

9:15 AM - 10:30 AM - Module 1

Design for Reliability Fundamentals

- Reliability Engineering Concepts
- Basic Definitions and Reliability Metrics
- Understanding Reliability Specifications
- Element of Reliability Requirements
- Hardware and Software Model Structure
- Reliability Functions and Applications
- Product or System Unreliability
- Critical Elements of Achieving Reliability
- Product Reliability Program
- Reliability Improvement Process Steps
- Product Design for Reliability Approach

10:30 AM - 1:15 PM - Module 2

Process for Developing Reliable System

- Reliability Requirements in Design
- System Level | Sub-system Design Analysis
 - DFMEA, FMECA, FMEDA
 - Fault Tree Analysis (FTA), PFMEA
- Reliability Block Diagram – System Modeling
- Similarity Analysis of a Physical Model
- Part Level Reliability Predictions
 - Physics of Failure Modeling
 - Empirical Models and Surrogate Data
 - Statistical Analysis of Parts Specific Data
 - Alternative Prediction Methods - Simulation
- System Level Prediction Methods
- Network Reliability Models
- Reliability Allocation Techniques
- Failure Reporting and Corrective Actions [FRACAS]

1:15 PM - 1:45 PM - Networking and Lunch



1:50 PM - 4:15 PM - Module 3

Design and Analysis of Experiment

- Elements of Experimentation
- Selecting Objectives of DOE
- DOE Strategies and Principles
- Experimental Design Steps
- Types of Design of Experiments
- Benefit of Integrating DOE in Design
- Components of DOE
- DOE Concepts and Application
- Experiment Design Process
- Application of Factorial Design
- Robust Design Application in Reliability
- Industry Example Applications.
 - Response Surface Methodology
 - DOE Application for Testing Software

4:15 PM - 4:25 PM - Tea and Networking

4:30 PM - 5:45 PM - Module 4

Human Factors in Reliable Design

- Human Factor Consideration in System Design
- Methods of Human Factor Analysis
- Interface Human Factors and Risks
- Managing the Risk of Use Errors
- System Design Environmental Considerations
- Fundamentals of Software User Interface
- Mobile Medical Devices Design Considerations
- Testing to Validate Human Factors in Design
 - Product Usability Analysis
- Human Reliability Analysis – HRA Models

5:50 PM - Chairman's Closing Remarks

DAY 2 - Schedule Based on Seminar Date

8:30 AM - Registration and Morning Coffee

9:00 AM - Chairman's Opening Remarks

9:15 AM - 10:30 AM - Module 5

Design Verification and Validation Testing

Session 1 – Fundamentals of Reliability Testing

- Definitions, Concepts, and Objectives
- Classification of Reliability Test
- Reliability Testing Methodologies
- Integrating Testing with DFR Flow
- Test Optimization Process Flow
- MTBF Methods in Reliability Testing
- Reliability Qualification Testing
- Application of Testing for Reliability

10:35 AM - 12:30 PM

Session 2 – Accelerated Life Testing [ALT] Concepts

- Methods of Applying Stress
- Classification of Acceleration Methods
- Accelerated Life Testing Procedure
- Development of Reliability Test Plans
- Reliability Data Collection Methods
- Performance Degradation Testing
- Models Applied in Accelerated Life Testing
- Using DOE to Support Accelerated Life Testing

12:30 PM - 1:15 PM - Networking and Lunch



1:20 PM - 2:00 PM

Session 3 – High Accelerated Life Testing [HALT]

- Methodology – Concept and Application
- HALT Limits and Issues
- Organizational Value of Performing HALT
- When to Use HALT Application
- High Accelerated Life Testing Procedure
- Comparing HALT and HASS
- Developing HALT Testing Report

2:05 PM - 4:05 PM

Session 4 – Product Testing and Field Reliability

- Screening [Burn-in, ESS, HASS]
- High Accelerated Stress Screening
- Attribute Testing – Zero Failure Testing
- Product Reliability Acceptance Test [PRAT]
- Weibull Life Data Analysis of Field Data
- Methods of Analyzing Repairable Systems

4:05 PM - 4:15 PM - Coffee and Networking



4:15 PM - 5:45 PM

Session 5 – Reliability Growth Testing Methodologies

- Overview of Reliability Growth Testing
- Crow AMSAA Analysis Procedure
- Models Applied in Development Testing
 - Duane
 - Logistic
 - Gompertz
 - Power Law
 - Lloyd Lipow
 - Crow Extended
- Predict Failures from Maintenance Record
- Reliability Growth Software Application

5:50 PM - Chairman's Closing Remarks

DAY 3 - Schedule Based on Seminar Date

8:30 - Registration & Morning Coffee

9:00 - Chairman's Opening Remarks

9:15 AM - 11:45 AM - Module 6

Product Risk and Safety Evaluation

- Elements and Types of Risk Analysis
- Factors Important to Medical Device Reliability
- Tools for Risk Estimation
 - FTA Model Application
 - PHA | FMEA | FMEDA | FMECA
- Verifying Compliance of Safety Requirements
- Product Liability Analysis [PLA]
- Product Liability Prevention Analysis

11:50 AM - 12:30 PM - Networking and Lunch



12:35 PM - 2:00 PM - Module 7

Models for Product Warranties

- Definitions and Types of Product Warranties
 - Free Replacement Warranties (FRW)
 - Pro Rata, Replacement Warranties (PRW)
 - Combined FRW | PRW
- Warranty Cost Models
- Determine Optimum Warranty Periods
 - Exponential Failure Times
 - Weibull Failure Times
- Determining Expected Warranty Cost
- Reliability Estimation from Warranty Claims

2:05 PM - 4:05 PM - Module 8

Validating Software Design Reliability

Session 1 – Software Reliability Design Analysis

- Reliability Definitions and Basic Concepts
- Software Reliability Design Considerations
- Principle of Software Reliability Measurement
- Software Risk Analysis [PHA, FTA, FMECA]
- Software Reliability Specification & Allocation
- Software Reliability Estimation Models
 - Failure Count Model
 - Fault Seeding Model
 - Input Domain Based Model
 - Time Between Failure Model
- Reliability of Safety Critical Software
- Implementing SRE on Existing Project

4:05 PM - 4:15 PM - Coffee and Networking



4:20 PM - 5:20 PM

Session 2 – Software Reliability Testing

- Basic Principles of Software Testing
- Methodology for Software Data Analysis

LebenTech's RMQ courses are extensively researched and structured to provide intensive and intimate professional development applicable to your organization.

5:25 PM - 5:45 PM - Presentation of Certificate



5:50 PM - Chairman's Closing Remarks

Design for Reliability Process

The DFR process described in the training contents emphasize methodologies that can be used to ensure that your company's products are reliably designed and parts are applied in a robust manner. This seminar presents an overview of the analytical tools that can be utilized to ensure a robust design, minimal variations and discusses several considerations for ensuring a manufacturable product. Figure 1 illustrates a representative design for reliability process.

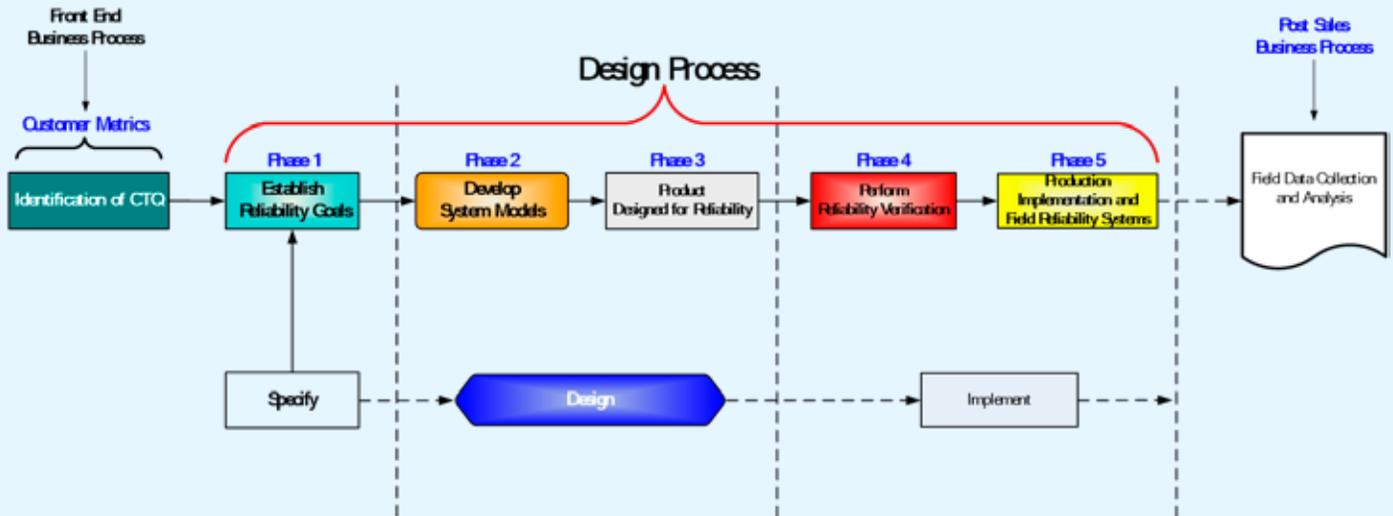


Figure 1: Design for Reliability Approach

A similar process should be embraced by companies for product design development. It includes: (1) Definition of operating environments (2) Establishment of lifetime requirements (3) Use of reliability models to estimate lifetime under use conditions (4) Estimates of reliability during the useful life (5) Stress derating (6) Analysis and design modifications to ensure robustness.

Several analytical techniques are useful in robust design and are integral features of the DFR process. These include derating, failure mode and effects analysis (FMEA) and FMECA, fault tree analysis (FTA,) and finite element analysis (FEA) and will be discussed as an integral aspect of the seminar content. These analyses are represented in figure 2.

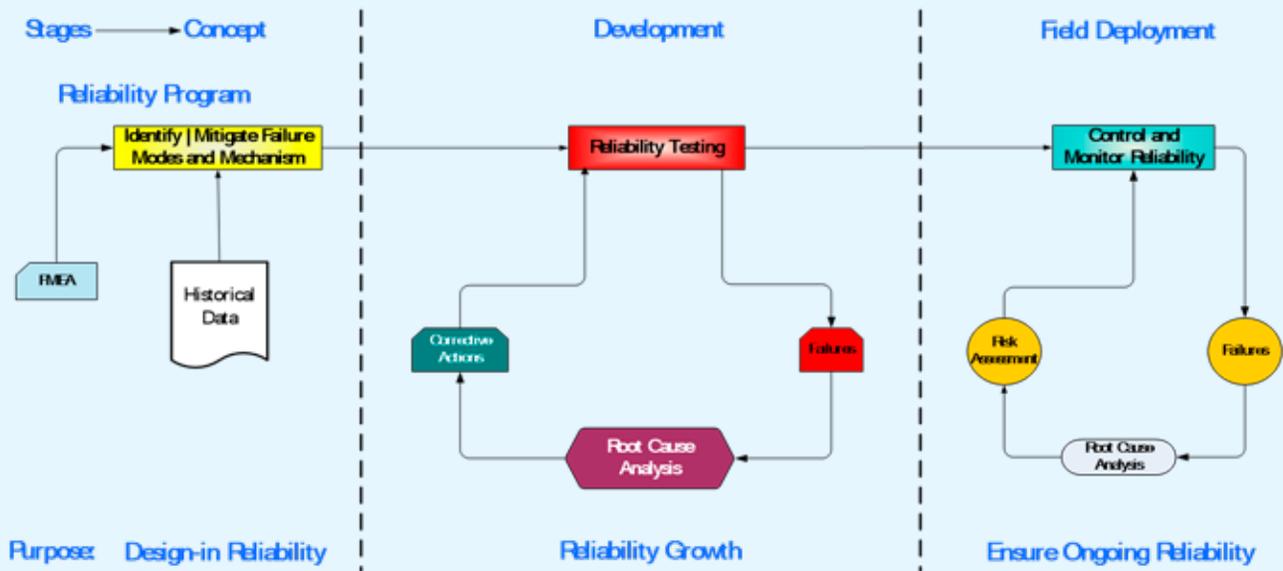


Figure 2: Phases of Reliability Program

DETAILS OF YOUR COURSE PRESENTER

LENNOX BENNETT



Mr. Lennox Bennett is the founder and lead Reliability Consultant at LebenTech Innovative Solutions Inc. He has more than 20 years of experience providing engineering services. His extensive experience includes application of reliability and maintainability analysis within the appliance, broadcast and wireless communication, medical device, telecommunication, printing, defense, aerospace and process industries. Lennox has detailed working knowledge of engineering design reliability concepts and application of these concepts to real world situations.

He is an expert in performing reliability analysis for different product design such as: emergency beacon, medical devices, communication devices, home appliances and commercial printing equipment during product development and for fielded products. His demonstrated analytical abilities in the application of Event and Fault Tree Techniques, RCM Analysis, Reliability Modeling, Engineering Risk Analysis, Warranty Analysis, Failure Mode Effect and Criticality Analysis, and Reliability Testing, enables him to provide the most comprehensive information to participants.

His deep experience in developing appropriate system reliability models and developing reliability test protocol for various product designs within industrial organizations have saved companies great amounts of time and money and reduce warranty cost. He utilizes this seminar to demonstrate how companies and their team can design reliability into their products and hence make it more robust and with minimum variability to perform successfully in its intended use environment. Mr. Bennett holds an M Sc. in Industrial Engineering from California Polytechnic State University and is a B S. in Manufacturing Engineering, from the University of Miami.

TESTIMONIAL FROM SIMILAR PAST EVENTS

Lecturer University of Technology Jamaica – Commented that the training material is very relevant to students and Lennox is very knowledgeable of subject and has excellent presentation skills.

Manager National Water Commission - Lennox is very knowledgeable in reliability and maintenance. Training will help us to better analyze current failures and in the selection of maintenance strategies.

Engineer Jamaica Public Service - The details provided on power system reliability could not be explained better for me to gain a better command of the subject. The training enables me to have a good understanding of reliability assessment methods.

Maintenance Engineer JAMACO – The training helps me realize the limitations of my knowledge with respect to world class equipment maintenance strategies. I have taken away new and extensive information to share with my team.

Student University of Technology Jamaica - The training will help students become more marketable in the work environment and will impact their employment prospects.

Reliability Engineer Desnoes & Geddes Limited (Red Stripe) - The training provides the opportunity to get clarification on reliability concepts I misunderstand. I will definitely recommend to other team members.

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- ◆ FRACAS.
- ◆ RCM Analysis.
- ◆ Safety Analysis.
- ◆ Product Validation.

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Given technological challenges and product complexity we recommend evaluation methods that engineering designers can apply to make informed judgments of the product risk associated with designing-out failures of critical system functions in a system.

Fundamental Reliability Engineering Techniques you can utilize to Transition from Reactive Product Development to Proactive Design Analysis for Reliable Performance.

In this seminar we are presenting an integrated approach to design analysis through reliability evaluation. **Product Design for Reliability Analysis of Complex Systems** provides comprehensive coverage of the most developed concepts of design reliability assessment, essential models, and various methods of analysis. It incorporates numerous illustrative examples from the electronics, medical device, household appliance, communication and military industries and problems in each module.

The first four modules sequentially provide essential elements of Design for Reliability, information regarding the application of experimentation to enhance product design reliability as well as engineering reliability methodologies that can be applied for developing a reliable system and contribution of human errors to unreliable design. It presents information useful for program planning and implementation.

This is followed by a detailed treatment of various reliability testing strategies utilized to verify and validate product reliability requirements. This module emphasizes Reliability Qualification Testing, Reliability Demonstration Testing, and Reliability Growth Testing. Special emphasis is given to the application of Design of Experiment to support Accelerated Life Testing and Software Testing.

The next module emphasizes methods of evaluating product design risks, integrating DFR with safety, and serves to quantify the contribution of reliability and risk to safe performance of the product. This is followed by a module which is focused on design for warranty cost reduction. The course concludes with an exclusive module on software reliability validation. Most modules are supported with a corresponding interactive exercise which serves to reinforce information learned.



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