eogogicsinc

Course ID
RCFA3D
Course Duration
3 days

Course Title
Root Cause Failure Analysis and Experiment Design Workshop

Related Courses

- Failure Modes and Effects Analysis: A Comprehensive Workshop (FMEA, 2 days)
- Root Cause Analysis of Systems Failure: A Tutorial (RCFA2D, 2 days)
- Root Cause Analysis of Component Failure: Understanding Human and Engineering Factors for Improved Product Performance (RCFA-ME, 2-4 days)
- Root Cause Failure Analysis: Workshop and Simulation (RCFA5, 5 days)
- Root Cause Analysis of Systems Failure: A Comprehensive Five Day Workshop (RCFA, 5 days)
- Industrial Statistics: A Tutorial (INDSTAT, 2 days)
- Design of Experiments: An overview (DOE1, 1 day)
- Design of Experiments: A Comprehensive Course and Workshop (DOE2, 2+ days)
- Quality Management (QUALMGT, 3 days)

Aimed At

This course is aimed at engineers, design engineers, process engineers, manufacturing engineering, quality assurance engineers, and scientists.

Group Size

5-25

Prerequisites

The course assumes an engineering or scientific background.

Course in a Nutshell

This course brings together important technical concepts to identify and eliminate the root causes of failures occurring in complex systems, subsystems, and components. The course emphasizes the development and implementation of a failure analysis methodology for use throughout an engineering organization.

We will show you how to utilize brainstorming, the 5-Why's technique, Ishikawa diagrams, mind-mapping, and fault tree analysis for identifying all potential failure causes. The course covers hardware analysis, statistical analysis, design evaluation, and other pertinent tools and techniques to evaluate potential failure causes and then zero in on the most likely causes.

The course includes design of experiments and other statistical evaluation techniques, including hypothesis testing, z-test, t-test, f-test (ANOVA), and Taguchi design of experiment technologies, with a special emphasis on selecting factors and factor ranges for Taguchi evaluation. Use of built-in Excel statistical analysis capabilities and templates for Excel-based Taguchi tests and operating characteristic curve evaluations provide a focused suite of failure analysis methodologies.

The course presents corrective action alternatives and a framework for selecting optimal intermediate and longer-term corrective actions. The course utilizes real-life case studies to help you apply these tools effectively. At the end of the course, you will have learned how to identify dominant failure modes through quantity and cost-based Pareto analyses, identify the root causes of systems failures, select and implement effective corrective actions, and work as an inter-organizational, multi-disciplinary failure analysis team.

Customize It!   Whatever the nature of your system and objective, whether failure prevention or cause determination, we will customize the course to meet your specific needs and concerns. Here are some of the ways in which we can tailor the course to help you get more out of it:

- Add additional "workshop time" to the course to allow the participants to work together to analyze failures specific to your organization. The workshop day can be scheduled a few weeks after the course to allow time for applying the technologies presented in class under an experienced failure analysis practitioner's guidance.
- Schedule post-class follow-up consultation for continuing in-house product and process failure analyses.

Learn How To
- Work together in an effective multi-disciplinary team environment to resolve complex system failures.
- Objectively identify all potential failure causes using fault tree analysis and other technologies.
- Objectively evaluate the likelihood of all potential failure causes.
- Utilize advanced Taguchi design of experiments and other statistical techniques.
- Identify the most likely failure causes.
- Proactively eliminate potential failure causes before they occur.

Course Outline

Day 1: Root Cause Failure Analysis and Cause Identification

- Introductory Concepts
    - o Root cause failure analysis philosophy
    - o The four-step problem solving approach
    - o Systems and component failures
    - o The inherent value of failed hardware
    - o Continuous improvement concepts and root cause failure analysis
    - o The value of a priori failure cause identification
    - o *Case Study: The Mast Mounted Sight*
    - o Class Discussion: Dominant Client Failures

- Identifying Potential Failure Causes
  - Brainstorming
  - Mind-mapping
  - The 5-Why's technique
  - Ishikawa diagrams
  - Fault tree analysis history, applications, and capabilities
  - Fault tree analysis construction
  - Fault tree gate usage and interpretation
  - Fault tree analysis quantification

- *Case Study: The VAMP Biomedical Device*

- *Group Exercises: Fault Tree Analysis Application to Client's Failures*

- Developing a Failure Analysis Action Plan
  - Using Failure Mode Assessment and Assignment (FMA&A) matrices
  - Failure analysis management
  - Failure analysis meetings
  - Failure analysis teams

- *Case Study: The Coagulation Filtration Water Treatment System*

- *Group Exercises: Developing FMA&A Plans for Client's Failures*

- *Homework Assignment: Laser Optics Debonding Case Study*

Day 2: Potential Failure Cause Evaluation and Relevant Statistical Concepts

- Case Study Review

- Evaluating Potential Failure Causes
  - "What's Different" analysis
  - Test and inspection data, material certifications, and SPC data
  - Flow charts for product performance and process evaluations
  - Failed hardware conformance assessment
  - Component failure analysis technologies, including optical microscopy, SEM, FTIR, EDAX, X-ray, N-ray, SIMS, and Auger analysis
  - Basic metallurgical and electronic component evaluations
  - Evaluating leaks

- *Case Study: The CBU-87/B*

- Basic Statistical Concepts and the Failure Analysis Relationship
  - The normal curve and design considerations
  - Excel evaluations for means, standard deviations, and composite standard deviations

- *Group Exercises: Identifying Statistical Considerations for Client's Failures*

- The Operating Characteristic Curve
  - The Binomial distribution

- o Producer versus consumer risk
- o Using Excel to evaluate the probability of passing a test

- *Group Exercises: Updating FMA&A Plans for Client's Failures*

Day 3: Statistical Evaluations, Corrective Action, Course Wrap-up

- Design of Experiments
    - o Intelligent test design
    - o Predicting outcomes
    - o Designing meaningful experiments
    - o Test readiness reviews
    - o Contingency planning

- Hypothesis Testing
    - o Stating the null hypothesis
    - o Z-tests
    - o T-tests
    - o Using Excel's built in statistics functions to simplify hypothesis testing

- Analysis of Variance
    - o ANOVA history
    - o The f-test
    - o Using ANOVA for assessing performance differences
    - o Designing tests to confirm failure causes
    - o Using Excel to simplify ANOVA testing
    - o ANOVA risks

- Taguchi Fractional Factorial Experiments
    - o Taguchi background
    - o Taguchi success stories
    - o The nature of fractional factorial experiments
    - o Factor selection
    - o Factor limit determination
    - o Calculations
    - o *Case Study: The Navy Aerial Refueling System*
    - o *Class Team Exercises: Taguchi Applications Discussion for Client's Failures*
    - o Using Excel to simplify Taguchi testing

- Corrective Action
    - o Corrective action definitions
    - o Corrective action order of precedence
    - o Design modifications
    - o Process modifications
    - o Requirements relaxation
    - o Screening
    - o Other corrective actions

- o Using the FMA&A matrix for corrective action identification and tracking
- o ***Case Study: Corrective Action Examples***

- Preventive Action
  - o Using failure analysis to guide preventive action identification and implementation
  - o Creating a product-oriented Lessons Learned document
  - o A suggested failure analysis procedure

- Recap, Q/A, and evaluations

How You Will Learn

- A seasoned consulting engineer-instructor will present this course in interactive lecture/workshop format.

- Along with the lecture, we use exercises, puzzles, case studies, and interesting group activities to enrich the class and drive home the key points.

- You will receive a Participant Handbook that includes all materials presented in class, which will help you remember and retain what you learned and apply it on your job.

- You will learn the key concepts of root cause failure analysis from a theoretical, practical, and organizational perspective.

Revision 2Jr-f