Course ID
RCFA4D
Course Duration
4 days

Course Title
Root Cause Analysis of Systems Failure: A Comprehensive Course

Related Courses

- Root Cause Analysis of Systems Failure: A Comprehensive Five Day Workshop (RCFA, 5 days)
- Root Cause Analysis of Systems Failure (RCFA2D, 2 days)
- Root Cause Analysis of Component Failure: Understanding Human and Engineering Factors for Improved Product Performance (RCFA-ME, 2-4 days)
- Systems Engineering: An Intermediate Tutorial and Workshop (SYSENG, 2 days)
- Succeeding at Technical Management: Do's and Don'ts for the Technical Manager (DOS&DONTS, 1 day)

Aimed At

This course is aimed at engineers, project engineers, design engineers, process engineers, program managers and others responsible for preventing or determining the causes of systems failures.

Group Size

5-25

Prerequisites

While there are no formal prerequisites, the course does assume a process, industrial, manufacturing, or engineering background.

Course in a Nutshell

This comprehensive four day course brings together important concepts from engineering, quality assurance, problem solving, procurement, and other disciplines 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 the organization.

We will show you how to utilize brainstorming, Ishikawa diagrams, mind-mapping, and fault tree analysis for identifying potential failure causes. We will also equip you with procedures and technologies for working through various types of systems failures. You will learn how hardware analysis, statistical analysis, design of experiments, technical data package evaluation, and other pertinent tools and techniques can be brought together to define potential root failure causes, and to develop a plan for evaluating these causes. 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 this toolkit effectively to your job. 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:

- Shorten the course to three days by omitting the design of experiments or other sections that are less pertinent to your work.
- Expand the course to a five-day workshop: Add a "workshop day" to the course to allow the participants to work together to analyze a failure 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, design of experiments, and other technologies.
- Objectively evaluate the likelihood of each potential failure cause.
- Identify the most likely failure causes.
- Proactively eliminate additional potential failure causes before they occur.

Course Outline

- Day 1: Identifying Potential Failure Causes
  - Systems failure analysis philosophy
  - The four-step problem solving approach
  - Systems and component failure analyses
  - The inherent value of failed hardware
  - Continuous improvement concepts
  - Nonconformance data bases and Pareto analysis
  - The value of a priori failure cause identification
  - Brainstorming, mind-mapping, and Ishikawa diagrams
  - Fault tree analysis history, applications, and capabilities
  - Relationships between logic operators and events
  - Fault tree gate usage and interpretation
  - Using inhibit functions to model probability distributions
  - Navigating from the failure site
  - Quantifying top undesired events
  - Failure rate sources
  - Using fault trees to identify redundancy-defeating failure modes
  - Case study
- Day 2: Evaluating Potential Failure Causes

- Using Failure Mode Assessment and Assignment (FMA&A) matrices
- "What's Different" analysis
- Using test and inspection data, material certifications, and SPC data
- Using flow charts for product performance and process evaluations
- Interviewing techniques for field personnel
- Customer/supplier interface issues
- Engineering design and tolerance analysis
- Failed hardware analysis
- Evaluating failed hardware conformance
- Quality Assurance compliance assessment tools
- Basic metallurgical and electronic component evaluations
- Component failure analysis technologies, including optical microscopy, NDT methods, SEM, Composition Analysis, FTIR, EDAX, X-ray, N-ray, SIMS, Auger and FEA
- Crack appearance in different loading geometries, including axial, Bending, Torsion, Direct shear, and Contact loading
- Classical microscale features, including ductile dimples, cleavage, intergranular irregularities, striations, and polymeric fractography
- Commercial failure analysis laboratories
- Evaluating leaks
- Testing to confirm failure causes
- Case study

- Day 3: Design of Experiments and Systems Failure Analysis
  - Basic experimental design concepts
  - Deterministic versus statistical thinking
  - Hypothesis testing
  - The normal distribution and other basic statistical concepts
  - Analysis of variance
  - Z-tests, t-tests, and f-tests
  - Identifying potentially critical design and process parameters
  - Identifying test objectives
  - Test readiness reviews
  - Inducing failures to confirm causes
  - Introduction to Taguchi philosophies and Taguchi design of experiment technologies
  - Designing a Taguchi experiment
  - Selecting test parameters
  - Two and three level orthogonal arrays
  - Selecting output parameters and data collection approaches
  - Defining test specimen configurations
  - Strategies for minimizing test risk
  - ANOVA applied to Taguchi experiments
  - Multiple level experiments
  - Case study
- Day 4: Corrective Action, Formalizing the Approach, and Course Wrap-up
  - Corrective action alternatives, including design modifications, process modifications, requirements relaxation, screening, and other corrective

actions
  - Statistical Process Control as a corrective action
  - Corrective action order of precedence
  - Corrective action implementation
  - Corrective action scope, including work in process, inventoried material, suppliers, and delivered equipment
  - Evaluating corrective action efficacy
  - Implementing corrective actions to address other hypothesized failure causes
  - Using the FMA&A matrix for corrective action identification and tracking
  - Preventing future failures
  - A suggested failure analysis procedure
  - Creating a product-oriented Lessons Learned document
  - Recap, Q/A, and evaluations

How You Will Learn

- A seasoned consulting engineer-instructor will present this course in an interactive lecture/workshop format.
- Along with the lecture, we use exercises, puzzles, case studies, and interesting group activities to enrich the instruction and highlight important concepts.
- You will learn the key concepts of root cause failure analysis from a theoretical, practical, and organizational perspective.
- You will receive a printed 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.

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