QUEST
Professional Center

PROFESSIONAL TRAINING COURSE

Course No. 1300

Failure Modes, Effects & Criticality Analysis (FMECA) Training Course

RELIABILITY & ASSET MANAGEMENT
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS

DURATION
5 Days

DELIVERY
Classroom

Course Overview

The Failure Modes, Effects & Criticality Analysis (FMECA) Training Course provides a structured and practical methodology for identifying potential failure modes, evaluating their effects, determining their criticality, and prioritizing actions to improve the reliability, safety, maintainability, and performance of equipment and systems. The course enables professionals to move from reactive failure response toward systematic risk-based reliability improvement.

FMECA is an important engineering and asset management methodology for organizations operating complex, safety-critical, or production-critical systems. By systematically examining how components can fail, what consequences those failures may create, and how critical each failure mode is, organizations can make better-informed decisions regarding equipment design, maintenance strategies, inspection programs, spare parts, operational controls, and reliability improvement initiatives.

The course provides a comprehensive approach to developing effective FMECA studies, beginning with system definition, functional analysis, and identification of failure modes and progressing through failure effects, causes, detection methods, severity, occurrence, detectability, and criticality assessment. Participants will learn how to distinguish between different levels of failure consequences and use structured analysis to focus resources on the most significant risks.

Through practical exercises, engineering case studies, and workshop-based analysis, participants will develop the ability to construct FMECA worksheets, evaluate failure consequences, calculate or rank criticality, identify single-point failures, and develop appropriate mitigation and improvement actions. The course also demonstrates how FMECA findings can support Reliability-Centered Maintenance, Root Cause Analysis, reliability improvement, asset criticality, maintenance optimization, and lifecycle management.

Objectives

- Analyze the fundamental principles of Failure Modes, Effects & Criticality Analysis and its role in reliability and asset performance management.
- Develop structured FMECA studies by defining system boundaries, functions, equipment hierarchies, and analysis levels during the course.

- Identify potential failure modes for equipment, components, systems, and operational processes using systematic engineering techniques.
- Evaluate local, subsystem, and system-level effects associated with identified failure modes.
- Assess failure causes, existing controls, detection methods, and operational consequences using structured analytical criteria.
- Apply severity, occurrence, and detectability criteria to establish consistent failure risk priorities.
- Calculate or rank failure criticality using appropriate quantitative and qualitative FMECA methodologies.
- Evaluate single-point failures, critical components, and weak links that may significantly affect system performance.
- Design practical corrective, preventive, inspection, and reliability improvement actions based on FMECA findings.
- Improve maintenance strategies by translating critical failure modes into appropriate preventive and predictive maintenance tasks.
- Strengthen the integration of FMECA with Reliability-Centered Maintenance, Root Cause Analysis, asset criticality, and reliability engineering programs.
- Develop a practical FMECA implementation and follow-up approach for continuous improvement within the organization.

Who Should Attend

The Failure Modes, Effects & Criticality Analysis (FMECA) Training Course is designed for professionals involved in reliability engineering, maintenance engineering, asset management, equipment performance, engineering design, operations, inspection, and risk-based decision making. It is particularly suitable for Reliability Engineers, Maintenance Engineers, Asset Engineers, Mechanical Engineers, Electrical Engineers, Instrumentation and Control Engineers, Process Engineers, Design Engineers, Maintenance Planners, Reliability Specialists, Inspection Engineers, and Technical Analysts.

The course is also highly relevant to Reliability Managers, Maintenance Managers, Engineering Managers, Asset Managers, Operations Managers, Plant Managers, Technical Services Managers, Maintenance Superintendents, and professionals responsible for developing maintenance strategies, equipment criticality assessments, reliability programs, inspection plans, or lifecycle management strategies.

Executives, project managers, engineering leaders, consultants, and technical decision makers can also benefit from understanding how FMECA supports risk-based prioritization and investment decisions. The methodology is applicable across manufacturing, power generation, utilities, transportation, mining, infrastructure, process industries, petrochemicals, oil and gas, and other asset-intensive environments.

Learning Outcomes

- Explain the principles, terminology, methodology, and applications of FMECA in reliability and asset management.
- Define appropriate system boundaries, functions, equipment hierarchies, and analysis levels for a structured FMECA study.
- Identify credible failure modes for components, equipment, subsystems, and systems.
- Analyze the local, subsystem, and system-level effects of individual failure modes.
- Determine potential failure causes and distinguish between physical, human, operational, design, and maintenance-related contributors.
- Evaluate existing prevention, detection, monitoring, and control measures associated with identified failure modes.
- Apply structured severity, occurrence, and detectability criteria to prioritize failure modes.
- Perform qualitative and quantitative criticality assessment using appropriate FMECA techniques.
- Identify critical equipment, single-point failures, weak links, and failure modes requiring priority action.
- Develop corrective and preventive actions that address high-priority failure modes and reduce operational risk.
- Translate FMECA results into maintenance, inspection, monitoring, spare parts, and reliability improvement recommendations.
- Integrate FMECA findings into broader reliability, maintenance, asset management, and continuous improvement programs.

Course Outline

DAY 01

Fundamentals of FMECA and System Reliability

- Introduction to Failure Modes, Effects & Criticality Analysis and its role in reliability engineering
- Relationship between FMEA and FMECA and the additional role of criticality assessment
- FMECA terminology, principles, objectives, applications, and limitations
- Defining system boundaries, equipment hierarchies, functions, and performance requirements
- Functional analysis and identification of system interfaces
- Understanding component, equipment, subsystem, and system-level failures
- Failure mode classification and failure mechanisms
- Sources of information for FMECA studies, including engineering documentation, operating history, and maintenance data
- Roles and responsibilities of multidisciplinary FMECA teams

PRACTICAL APPLICATION

Define a system, establish its functional hierarchy, and prepare the initial structure of an FMECA study

DAY 02

Failure Mode and Failure Effect Analysis

- Systematic identification of potential failure modes
- Failure mode identification techniques and engineering judgment
- Failure causes and mechanisms
- Distinguishing failure modes from failure causes and failure effects
- Local effects, subsystem effects, and end effects
- Safety, operational, production, environmental, and maintenance consequences
- Identification of single-point failures and functional dependencies
- Existing prevention, detection, monitoring, and control measures
- Developing clear and technically meaningful FMECA descriptions

DAY 02 — CONTINUED

> **PRACTICAL APPLICATION**
> Develop an FMECA worksheet for selected equipment and identify failure modes, causes, and effects

DAY 03

Criticality Assessment and Risk Prioritization

- Principles of failure criticality assessment
- Qualitative and quantitative FMECA methodologies
- Severity classification and consequence assessment
- Occurrence and failure probability evaluation
- Detectability and effectiveness of existing controls
- Criticality matrices and risk ranking approaches
- Criticality number concepts and quantitative criticality calculations
- Identifying high-criticality failure modes and system vulnerabilities
- Evaluating uncertainty and limitations in criticality assessments
- Prioritizing engineering and maintenance resources based on FMECA results

> **PRACTICAL APPLICATION**
> Conduct a criticality assessment and rank failure modes according to their impact and probability

DAY 04

FMECA-Based Reliability and Maintenance Improvement

- Converting FMECA findings into reliability improvement actions
- Developing preventive and predictive maintenance tasks from identified failure modes
- Linking failure modes with inspection, condition monitoring, testing, and maintenance requirements
- Using FMECA to support Reliability-Centered Maintenance
- Integrating FMECA with Root Cause Analysis and failure investigation

DAY 04 — CONTINUED

- Developing design improvements and engineering modifications
- Spare parts strategy and critical component identification
- Evaluating redundancy, protection systems, and mitigation measures
- Establishing action priorities, responsibilities, deadlines, and performance indicators
- Monitoring the effectiveness of FMECA recommendations after implementation

PRACTICAL APPLICATION

Develop an improvement plan for high-criticality failure modes and translate findings into maintenance and reliability actions

DAY 05

FMECA Implementation, Integration and Continuous Improvement

- Building an organizational FMECA methodology and governance framework
- Selecting systems, assets, and processes for FMECA studies
- Establishing FMECA data requirements and documentation standards
- Conducting multidisciplinary FMECA workshops effectively
- Reviewing, validating, and updating FMECA studies as assets and operating conditions change
- Integrating FMECA with asset criticality, maintenance strategy, reliability improvement, and lifecycle management
- Using FMECA findings to support engineering design, procurement, commissioning, and operational readiness
- Developing FMECA performance indicators and follow-up mechanisms
- Using lessons learned and operational data to continuously improve FMECA models

FINAL WORKSHOP

Complete an end-to-end FMECA study, prioritize critical failure modes, develop improvement actions, and prepare an implementation plan

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Register or Request More Information

Course page: https://quest-training.com/courses/failure-modes-effects-criticality-analysis-fmeca-training-course
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