

# € TRAINING

Economic & Technical Evaluations in  
Engineering & Maintenance Projects





# Economic & Technical Evaluations in Engineering & Maintenance Projects

## Introduction:

Engineering and maintenance projects call for complex engineering and business trade-offs with due regard to compliance with regulatory and code requirements. A sound understanding of the key aspects of project objectives, drivers, constraints, and profitability is crucial for the success of a project. Fast-track schedules demand faster, more accurate technical and economic decisions earlier in the design process when engineers and business managers least understand project costs. Consequently, many process facilities cost more than they should.

Using the appropriate evaluation techniques and skills, engineering and economic decisions can be reached faster, more accurately, and with greater confidence, avoiding costly project delays and potential rework.

In cases where there is competition for resources between several technically viable projects, cost and schedule factors play a key role in ranking the projects based on their profitability. Similarly, costs and schedules have a major impact on the selection of the most cost-effective maintenance option from among several alternatives such as repair/replace or long/short term repairs.

This Economic & Technical Evaluations in Engineering & Maintenance Projects training course covers the basics of project development and management. It begins with the Project initiation and development phases and progresses through the project execution and control phase. It highlights the cost considerations and the degree of influence on costs in each phase.

The technical viability of a project, whether it involves new facilities or a repair method, must be ensured before the economic evaluation starts. The training course presents the technical fundamentals and provides guidelines and procedures for conducting technical evaluations.

The time value of money and life cycle cost concepts are essential aspects of economic evaluations. These topics will be covered in detail with the use of a number of worked examples.

This Economic & Technical Evaluations in Engineering & Maintenance Projects training course will comprise lectures and workshops that incorporate a number of short exercises to reinforce the key techniques discussed to maximize your benefits. Additionally, an optional "Question and Answer" period will provide you with opportunities to get expert answers to your specific questions.

## Course Objectives:

At the end of this course the participants will be able to:

- Provide a fundamental understanding of financial and accounting principles, terms, techniques, and best practices
- Provide The tools you need to perform financial evaluations and justify your own project to corporate management
- Provide a fundamental understanding of the technical aspects that should be considered in technical evaluations of projects to ensure their technical viability, mechanical integrity and compliance with applicable regulations, codes, and standards

## Targeted Audience:

Design, project, maintenance, and plant engineers, supervisors, and professionals in the manufacturing, chemical processing, petrochemical, power, food, and other process industries. New graduates will benefit within a short period of two days from the extensive practical experience of the instructor.

## Course Outlines:

### Unit 1: Project Initiation and Development:

- Overview
  - Definitions of terms used in project development, analysis, and management
  - Project types and sizes
    - Capital projects - Evergreen, expansions/additions, revamps
    - Maintenance projects - Shutdowns; repairs; alterations; replacements and improvements
  - Project definition, scope, and drivers
    - Project mission and drivers
    - Phase 1: Concept generation - potential ways of achieving project mission
    - Phase 2: Project definition - one option is selected and developed
    - Phase 3: Project implementation - continues through construction to the hand-over of the completed project
  - Project Management Process
    - Project Planning
    - Project Scheduling
    - Feasibility study - Is the project feasible? How feasible are the alternatives under consideration; feasibility report
    - Cost, timing, performance, the effect of organization
  - Key issues in project analysis
- Models of project development
  - Project evolution and life cycle
  - Basic seven phases of a project
  - Common three main phases of a project
    - Front End Loading -FEL or Front End Definition - FEED which includes the development of the entire detailed plan and project approvals
    - Execution Phase - Detailed engineering; procurement, construction
    - Commissioning, Handover and Start-up phase
  - Project definition
    - Design Basis Document DBD - Development guidelines
    - Implementation strategy - owner involvement
    - Procurement policies, procedures, and practices
    - Spare parts policies, procedures, and practices
    - Detailed definitive cost estimate
  - Project development
    - Project Development Plan PDP - Preparation Guidelines
    - Conceptual design alternatives
    - Preliminary cost estimates for alternatives
    - Responsibility charting for stakeholders
    - Selection guidelines for final design alternative
    - Preliminary feasibility analysis - technical and economic feasibility
    - Preliminary schedule

- Project execution and control
  - Project Execution Plan PEP - How to develop an effective execution plan
  - Coordination and Control Procedures
  - Detailed Schedule
  - Detailed Engineering
  - Safety Process Hazard Analysis
  - Construction - Logistics, work Permits, Safety
  - Quality Control / Quality Assurance
  - Project Change Management System
  - Progress Monitoring and reporting
  - Project Management Tools

## Unit 2: Technical Evaluation Analysis:

- Project Risk and Contingency Analysis
  - Key issues in project analysis
    - Market analysis - Supply and demand
    - Technical analysis - Technical viability; sensible choices
    - Financial analysis - financial viability; return on investment; risk
    - Economic analysis - social cost-benefit
    - Environmental analysis - likely ecological damage; restoration measures/costs
    - Risk analysis - Levels of risk associated with the project
  - Analysis of project technical and engineering aspects
    - Purpose of technical analysis
    - Technical viability
      - Design basis
      - Existing and proven technologies
      - New and developmental technologies
      - Regulatory approvals - lead time, resources
      - Risk considerations - obsolescence, continuous technical support
    - Sensible choices
      - Location
      - Process, equipment, methods, procedures
      - Size - optimal scale of operation
      - Constructability, operability and maintainability
      - Availability of human resources, power, and other inputs
      - Realistic work schedule
  - Applicable regulations, codes, standards - design and construction, HSE
  - Mechanical integrity, management of change
- Environmental analysis
  - Consideration on environmental aspects
    - What is the likely damage caused by the project to the environment?
    - What is the cost of restoration measures required to ensure that the damage in the environment is contained within acceptable limits?
  - Applicable regulations and specifications
  - Due diligence
- Project risk considerations

- Types of Risks Associated with Projects
  - Market risk
  - Human resource
  - Financial resources
  - Technology risk
  - Management risk
  - Timing
  - Intellectual property right issues
  - Regulation risks
- Risk assessment methods and recommended practices
- Risk Management and Contingency
  - Level of uncertainty in the project life cycle
  - Risk analysis and mitigation measures
  - Contingency

### Unit 3: Economic Evaluation Analysis:

- Objectives of economic evaluation analysis
  - Definitions and overview
  - Typical categories of engineering economic decisions
    - New Product and Product Expansion
    - Equipment and Process Selection
    - Equipment Replacement
    - Cost Reduction
    - Service Improvement
- Economic financial evaluation
  - Introduction
  - Basic concepts of economic evaluation
  - Economic evaluation methods - static and dynamic
    - Simple payback
    - Benefit-Cost Ratio BCR
    - Net Present Value NPV
    - Internal Rate of Return IRR
  - The capital equivalent of energy and maintenance savings
- Principles of time value of money and the discount rate
  - Discounted Cash Flow DCF Calculation - Definitions and premises
  - Project Cash Flow Components
  - Discounting and time-value considerations
  - Distinguishing cash flow and other measures of profitability
  - Cost of capital and inflation issues
  - Capital budgeting techniques and best practices
  - Methods of computing time-value of money
    - The algebraic or formula method
    - The financial table method
    - The financial calculator method
- Methods of ranking investment proposals
  - Non-Discounted Cash Flow Methods
    - Payback method or Payback Period
    - Accounting Rate of Return ARR



- Discounted Cash Flow Methods
  - Net Present Value Method NPV
  - Internal Rate of Return IRR
- Profitability Index PI

#### Unit 4: Business Focused Facilities:

- Business-Focused Facilities BFF
  - An economic interpretation of engineering work
  - Fundamental BFF principles
    - Total cost full cycle perspective
    - Common and clear goals
    - Adaptive process and change management
    - Teamwork
    - Continuous improvement
- Life-cycle total cost analysis
  - Basics of Life Cycle Cost LCC Analysis
  - LCC Models - SAE model
  - Life-Cycle Management Value Management
    - Renewal/replacement intervals
    - Servicing costs
    - Failure consequences
    - Asset redundancy
    - Maintenance strategies
    - Energy efficiency
    - Design life service factor
- Effective Life-Cycle Management Tools
  - Engineering economics
  - Remaining life estimates
  - Statistical analysis
  - Opportunity costing
  - LCC Calculation Procedures
- Project cost estimating
  - Types of estimates, accuracy
  - Estimating methods
  - Cost indices and economic indicators
  - Direct and indirect costs
  - Computer-based estimating
- Equipment sizing and costs
  - Power Sizing Model
  - Rough estimates
  - Semi-detailed estimates
  - Detailed estimates

#### Unit 5: Evaluation of Maintenance Projects:

- Types of maintenance projects
  - Complete turnarounds - extent, frequency
  - Opportunistic minor turnarounds

- Specialized repair methods
- Replacement in kind and improvement opportunities
- Specialized Inspection Projects - Application and frequency
- Concept of component life
  - Introduction
  - Physical life
  - Economic life
  - Technical life - technical obsolescence
- Technical evaluation of maintenance projects
  - Key project characteristics and special requirements
    - Significance of schedule and maintainability - optimum cost or least downtime
    - Availability of human resources
    - Constructability considerations
  - Fitness-For-Service Assessments FFS
    - Basics of FFS
    - Run/repair/replace decisions
  - Alternative repair strategies and methods
    - Temporary repairs
    - Permanent repairs
  - Alternate repair technologies and procedures
  - Management of change
    - Basics of management of change
    - Impact of maintenance projects on mechanical integrity and reliability
    - Regulatory, codes and standards requirements