

# Certified Software Quality Engineer Preparation Course Offered by The Westfall Team

## Certified Software Quality Engineer

**Preparation** course is a 5-day course design to be a comprehensive, in-depth review of the topics in the ASQ's Certified Software Quality Engineer (CSQE) Body of Knowledge. This course:

- Helps CSQE candidates prepare for and perform well on the ASQ CSQE exam
- Provides an excellent knowledge base for anyone interested in implementing or improving Software Quality Engineering techniques and practices in their organization

**Method of Instruction:** This course is taught primarily through lecture with time for questions and interactive discussions. Actual examples from the software industry are utilized to make the information relevant. The emphasis is on knowledge transfer that allows the attendees to transition their learning to their own work environments.

**Target Audience:** CSQE exam candidates, software quality engineers, developers, testers, project managers, functional managers, requirements analyst, and other software stakeholders who will be involved in planning and managing software projects, developing software and/or assuring its quality.

**Detailed Outline:** This course follows the outline of the Software Quality Engineering Body of Knowledge as defined by ASQ:

### I. General Knowledge

#### A. Benefits of Software Quality Engineering within the Organization

- Quality Defined
- Software Quality – Areas of Knowledge
- Benefits of Software Quality
- Increasing Costs of Fixing Defects
- Kano Model

#### B. Ethical & Legal Compliance

1. ASQ Code of Ethics for Professional Conduct
  - ASQ Code of Ethics
  - Conflict of Interest
2. Legal & Regulatory Issues
  - Regulations
  - Contracts
  - Intellectual Property Rights

- Tort Lawsuits
- Data Privacy

#### C. Standards & Models

- Definitions
- ISO 9000 Family of Standards
- 7 Quality Management Principles
- ISO 9001:2015 – Quality Management System
- IEEE Software Engineering Standards
- CMMI<sup>®</sup> Staged Representation Levels & Process Areas
- CMMI<sup>®</sup> Definition Components
- CMMI<sup>®</sup> Specific Goals & Practices – Example
- CMMI<sup>®</sup> Generic Goals & Practices
- CMMI<sup>®</sup> Staged Representation – Maturity
- CMMI<sup>®</sup> Continuous Representation – Capability

#### D. Leadership Skills

1. Organizational Leadership
  - Leadership Defined
  - Qualities of an Effective Leader
  - Organizational Change Management
  - Change Models
  - Motivation
  - Herzberg's Motivation-Hygiene Factors
  - Rewards & Motivation
  - Knowledge Transfer
  - Mentoring
  - Coaching
  - Agile Coaching
  - Situational Leadership
2. Facilitation Skills
  - Facilitation
  - Views of Conflict
  - Benefits of Conflict
  - Not Enough Good Conflict
  - Reducing Conformity
  - Negative Conflict
  - Conflict Resolution Strategies
  - Negotiation
  - Productive Meetings
3. Communication Skills
  - Communication Models
  - Typical Message Problems
  - Types of Verbal Communications

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- Types of Written Communication
- Impacts of Communications on Quality
- Effective Listening
- Interviewing
- Interview Questions
- Open Ended Questions
- Context Free Questions
- Multicultural Environments
- Cultural Competence
- Leadership Skills & Agile

## E. Team Skills

1. Team Management
  - Team Strengths & Weaknesses
  - Types of Quality Teams
  - Team Roles & Responsibilities
  - Stages of Team Development
  - Handling Team Problems
  - Working with Diverse Teams
  - Virtual Teams
2. Team Tools
  - Brainstorming
  - Nominal Group Techniques
  - Affinity Diagram
  - Multi-Voting Techniques
  - Prioritization Matrices
  - Prioritization Graph
  - Force Field Analysis

## II. Quality Management System

### A. Quality Management System

1. Quality Goals & Objectives
  - Quality Management System Defined
  - Purpose of a QMS
  - Quality Goals
  - Quality Objectives
  - Quality Planning Hierarchy
  - Software QMS Documentation Hierarchy
  - Benefits of Standardized Processes
  - ETVX Process Definition
  - Entry & Exit Criteria – Examples
  - Process Definition Critical Attributes
  - Process Documentation – Example
  - Process Architecture
  - Standardized Work Instructions
  - Project-Level Quality Plans
  - Software Quality Assurance Plan (SQAP)
  - Project Specific or Tailored Processes & Work Instructions
2. Customers & Other Stakeholders
  - Types of Stakeholders
  - Benefits of Identifying & Involving Stakeholders
  - Prune Stakeholder List
  - Stakeholder Participation Strategy
  - Stakeholder Needs & Motivations

3. Outsourcing
  - Ways to Outsource
  - Benefits of Outsourcing
  - Risk of Outsourcing
  - Acquisition Process
  - Initiate & Plan the Acquisition
  - Define the Software Product
  - Determine the Acquisition Approach
  - Identify & Evaluate Potential Suppliers
  - Define Contract Requirements
  - Select a Supplier
  - Negotiate & Award Contract
  - Manage Supplier
  - Integrated Product Team
  - Accept Product & Close Contract
4. Business Continuity, Data Protection & Data Management
  - Business Continuity
  - Business Continuity Management
  - Data Security
  - Data Protection
  - Data Management
  - Data Management Principles
  - Functions of Data Management

### B. Methodologies (for Quality Management)

1. Cost of Quality (COQ) & Return on Investment (ROI)
  - Cost of Quality
  - Cost of Quality Categories
  - Optimal Cost of Quality
  - Return on Investment (ROI)
2. Process Improvement
  - Benchmark Defined
  - Benchmark Process
  - Plan-Do-Check-Act (PDCA) Model
  - Six Sigma
  - DMAIC vs. DMADV
  - Lean Techniques
  - The Seven Wastes
3. Corrective Action Procedures
  - Corrective Action
  - Correction vs. Corrective Action
4. Defect Prevention
  - Corrective vs. Preventive
  - Process & Culture
  - Training & Mentoring
  - Technical Reviews
  - Other Prevention Techniques

### C. Audits

- Audits Defined
- Audit Objectives
- Audit Principles
- Audit Program
- Independence & Objectivity

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1. Audit Types
  - Types of Audits
  - Internal Audits
  - External Audits
  - System Audits
  - Process Audits
  - Product Audits
  - Project Audits
  - Supplier Audits
  - Follow-Up Audits
  - Desk Audit
2. Audit Roles & Responsibilities
  - Participant Roles
  - Client
  - Auditor Management
  - Lead Auditor
  - Auditors
  - Auditee Management
  - Auditee
  - Escort
3. Audit Process
  - Audit Steps
  - Audit Initiation
  - Audit Plan
  - Prepare for the Audit
  - Audit execution
  - Opening Meeting
  - Gathering Objective Evidence
  - Checklists
  - Tracing
  - Sampling
  - Closing Meeting
  - Turning Requirements into Audit Results
  - Audit Report
  - Corrective Action
  - Corrective Action Plan
  - Evaluating the Corrective Action Plan
  - Verification Follow-Up

- Agile
- Methodology Triangles
- Scrum
- Scrum Roles
- Scrum Process
- Extreme Programming (XP)
- Choosing a Model

## B. Systems Architecture

- Levels of Architecture & Design
- System Architecture Styles
- N-Tier Application Architectures
- Client Server Architectures
- Peer-to-Peer Architectures
- Web Architectures
- Collaborative Platforms

## C. Requirements Engineering

- Requirements Defined
  - Why are Requirements Important?
  - Requirements Engineering Process
2. Product Requirements
    - Functional Requirements
    - Interface Requirements
    - Performance Requirements
    - Globalization – Internationalization Requirements & Localization
    - Design Constraints
  3. Data/Information Requirements
    - CURDL
    - Other Data Management Requirements
    - Data/Information Integrity
    - Data Dictionary
  4. Quality Requirements
    - Quality Attributes
    - Reliability & Availability Requirements
    - Usability Requirements
  5. Compliance Requirements
    - Business Rules including Regulatory Requirements
    - Safety Critical Software
    - Safety Requirements
  6. Security Requirements
    - Software Security Defined
    - Security Requirements
  7. Requirements Elicitation Methods
    - Vision, Scope & Limitations
    - Direct Two-Way Communications
    - Focus Groups
    - Facilitated Requirements Workshops
    - Other Requirements Elicitation Techniques
    - Capturing Stakeholder Needs – User Stories
    - Capturing Stakeholder Needs – Use Cases
    - Capturing Stakeholder Needs – Story Boards
  8. Requirements Evaluation
    - Requirements Analysis – Models

## III. System & Software Engineering Processes

### A. Life Cycle & Process Models

1. Waterfall Software Development Life Cycle
  - Software Life Cycle Models
  - Waterfall Model
  - V Model
  - W Model
2. Incremental/Iterative Software Development Life Cycle
  - Spiral Model
  - Iterative Model
  - Incremental Development
  - Iterative Model & Incremental Development
  - Evolutionary Model
3. Agile Software Development Life Cycle

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- Data Flow Diagrams
- Entity Relationship Diagrams
- State Transition Diagrams
- Class Diagrams
- Sequence Diagrams
- Activity Diagrams
- Event/Response Tables
- Requirements Validation – Requirements Peer Reviews
- Evaluating Requirements Checklist
- Test Matrix – Example
- Prioritizing Requirements

### D. Requirements Management

1. Requirements Change Management
2. Bi-Directional Traceability

### E. Analysis, Design & Development

1. Design Methods
  - Analysis, Design & Implementation
  - Goals of Analysis & Design
  - Design Concepts
  - Software Analysis & Design Process
  - Structured Design & Analysis
  - Object Oriented Design
2. Quality Attribute & Design
  - Quality Attributes & Design – Safety
  - Quality Attributes & Design – Security
  - Quality Attributes & Design – Reliability & Availability
  - Quality Attributes & Design – Usability
  - Quality Attributes & Design – Performance
  - Quality Attributes & Design – Maintainability
3. Software Reuse
  - Reuse
  - Reengineering
  - Reverse Engineering
4. Software Development Tools

### F. Maintenance Management

1. Maintenance Types
2. Maintenance Strategies
  - Maintenance Process Implementation
  - Problem & Modification Analysis & Implementation
  - Migration
  - Retirement & Product Discontinuance
3. Customer Feedback Management

### IV. Project Management

- Project Defined
- Project Management Process
- Project Life Cycle Phases
- Cost/Schedule/Product Trilogy
- Project Success

### A. Planning, Scheduling & Deployment

1. Project Planning

- Goals of Software Project Planning
  - Project Planning
  - PMI Project Planning Process Group
  - Project Charter
  - Project Objectives
  - Environmental Factors & Process Assets
  - Long-Term vs. Near-Term
  - Project Estimates & Forecasts
  - Estimation Methods – Expert Judgment
  - PERT
  - Expert Judgment – Strengths & Weaknesses
  - Estimation Methods – Model Based
  - Model Based - Strengths & Weaknesses
  - Activity Networks
  - Activity Network Relationships
  - Critical Path
  - Schedule Duration
  - Staff & Resource Allocation
  - Multiple Critical Paths
  - Budget
2. Work Breakdown Structure (WBS)
    - Benefits of a WBS
    - Types of Work Breakdown Structure
    - Breaking Projects into Tasks
  3. Project Deployment
    - PMI Executing Process Group
    - Acquire, Develop & Manage Project Team
    - Project Communications
    - Manage Stakeholder Engagement

### B. Tracking & Control

- Tracking
  - Control
  - Monitor & Control – Goals
  - PMI Monitoring & Control Process Group
1. Phase Transition Control
    - Verifying Entry & Exit Criteria
    - Quality Gate
    - Gantt Charts
    - Integrated Master Schedule
    - Actuals vs. Estimates
    - Project Control
    - Project Corrective Action Process
  2. Tracking Methods
    - Earned Value
    - Earned Value Metrics
    - Earned Value Calculations – Example
    - Earned Value Tracking
    - Tracking Deliverables
    - Tracking Productivity & Velocity
    - Staff & Resource Tracking
    - Requirements Management
  3. Project Reviews
    - Phase Gate Reviews
    - Project Team Status Reviews

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- Management Reviews
  - Post Project Reviews
4. Program Reviews
    - Program Defined
    - Program Reviews

## C. Risk Management

- Risk Defined
  - Risk/Opportunity Balance
  - Project Management & Risk Management
  - Risk Exists
2. Risk Management Methods
    - Risk Management Process
    - Risk Identification
    - Risk Identification Techniques
    - Types of Risks
    - Communicating Risks
    - Risk Statement
    - Risk Analysis
    - Risk Context
    - Risk Probability
    - Loss Analysis
    - Risk Exposure
    - Risk Timeframe
    - Risk Planning
    - Techniques for Handling Risks
    - Risk Reduction Leverage
    - Adjust Project Plans
    - Taking Action
    - Track Risks
  3. Software Security Risk
    - Software Assurance – Digital & Physical
    - Software Security Attacks, Attacks & Paths
    - Software Security Threats
    - Security Risk Analysis
    - Software Security Risk Management
  4. Safety & Hazard Analysis
    - Software Safety Risk
    - Software Safety Activities
    - Hazard Analysis & Safety Mitigation Process
    - FMEA
    - Safety Risk Mitigation

## V. Software Metrics & Analysis

### A. Process & Product Measurement

1. Terminology
  - Software Metric Defined
  - Measurement Defined
  - Data to Information to Knowledge
  - Validity & Reliability
  - Explicit vs. Derived Measures
  - Metric Models
  - Measurement Scales
  - Variation
  - Statistics – Location
  - Statistics – Variance

- Statistics – Distribution
- Statistics – Common Cause vs. Special Cause

### 2. Software Product Metrics

- Identify Metrics Customers
- Goal/Question Metric Paradigm
- Target Goals
- Ask Questions
- Select Metrics
- Software Product Entities & Attributes
- Size – Lines of Code
- Size – Function Points
- Size – Other Size Metrics
- Complexity – Cyclomatic Complexity
- Complexity – Structural Complexity
- Quality – Defect Density
- Quality – Arrival Rate
- Quality Problem Report Backlog
- Quality – Data Quality
- Amount of Test Coverage Needed
- Requirements Volatility
- Reliability & Availability
- System & Software Performance
- Maintainability Metrics
- Usability Metrics

### 3. Software Process Metrics

- Software Process Entities & Attributes
- Process Cost
- Defect Prevention – First Pass Yield
- Cycle Time
- Customer Impact – Customer Satisfaction
- Customer Impact – Responsiveness to Reported Problems
- Effectiveness – Escapes
- Defect Containment Effectiveness
- Defect Removal Efficiency (DRE)
- Process Capability
- Agile Metrics

### 4. Data Integrity

- Data Collection Goals
- Who Should Collect the Data?
- Quality Data & Measurement Error
- Data Accuracy
- Data Completeness
- Data Timeliness
- Consider the Human Factors
- Human Factors – What Not to Do
- Human Factors – What to Do

### B. Analysis & Reporting Techniques

#### 1. Metrics Reporting Tools

- Graphical Techniques
- Stoplight Charts
- Dashboards
- Kiviat Charts

#### 2. Classic Quality Tools

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- Flow Charts
  - Pareto Chart
  - Cause-and-Effect Diagram
  - Check Sheets
  - Scatter Diagrams
  - Run Charts
  - Histograms
  - Control Charts
3. Problem Solving Tools
- Affinity Diagram
  - Tree Diagram
  - Matrix Diagram
  - Interrelationship Digraph
  - Root Cause Analysis

3. Test Design
- Test Planning and Design Activities
  - Equivalence Class Partitioning
  - Boundary Value Testing
  - Fault Insertion
  - Fault-Error Handling
  - Cause-Effect Graphing
4. Software Test
- Levels of Testing
  - Testing Each Function
  - Environment in Which Function Operates
  - Testing Usage Scenarios
  - Operational Profile Testing
  - Performance Testing
  - Load, Volume & Stress Testing
  - Worst Case testing
  - Resource Utilization Testing
  - Usability Testing
  - Exploratory Testing
  - Regression Testing
5. Tests of External Products
- Third-Party Software Testing
  - COTS & Open Source Testing
  - Custom-Built Third Party Software
6. Test Coverage of Specification
- Traceability
  - Test Matrix – Example
  - State Testing
  - Data Domain Testing
  - Date & Time Domain Testing
  - Interface Coverage
  - Security Coverage
  - Platform Configuration Coverage
  - Internationalization Testing
7. Code Coverage Techniques
- Types of Condition/Decision Coverage
  - Domain & Boundary Testing
8. Test Environments
- Test Bed
  - Stubs & Drivers
  - Harnesses
  - Controlling Test Environments
9. Test Tools
10. Test Data Management
- Test Data Items
  - Test Data Management

## VI. Software Verification & Validation

### A. V&V Theory

1. V&V Methods
- Verification & Validation Defined
  - V&V Methods – Static Analysis
  - V&V Methods – Dynamic Analysis
  - V&V Task Iteration
  - V&V Sufficiency
2. Software Product Evaluation
- Requirements & Design V&V Techniques
  - Source Code V&V Techniques
  - Build V&V Techniques
  - Test Case & Test Procedure V&V Techniques
  - Documentation V&V Techniques
  - Other Work Product V&V Techniques
  - Risk-Based V&V
  - V&V Plan

### B. Test Planning & Design

1. Test Strategies
- Testing Defined
  - When to Test
  - Test Activities
  - White-Box Testing
  - Gray-Box Testing
  - Top-Down Integration & Test Strategy
  - Bottom-Up Integration & Test Strategy
  - Black-Box Testing
  - Test-Driven Design (TDD)
  - Risk-Based Testing
  - Time-Box Testing
  - Good Enough Testing
  - Simulation
  - Test Automation
2. Test Plans
- Test Planning Documents
  - Test Planning Documents – Test Plans
  - Test Planning Documents – Test Design Specification

### C. Reviews & Inspections

- Management Reviews
- V&V Review Objectives
- Technical Reviews
- Pair Programming
- Benefits of Peer Reviews
- Selecting Peer Reviewers
- Informal vs. Formal Peer Reviews
- Peer Review Types & Formality

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- Types of Peer Reviews
- Desk Checking Process
- Walk-Through Process
- Inspection Process

### D. Test Execution Documentation

- Testing Activities – Test Execution
- Test Execution Documentation
- Test Execution Documentation – Test Cases
- Test Execution Documentation – Test Procedures
- Test Execution/Results Documentation – Test Log
- Test Execution/Results Documentation – Problem Report
- Test Execution/Results Documentation – Results Data/Metrics
- Test Execution/Results Documentation – Test Completion Report

## VII. Software Configuration Management

### A. Configuration Infrastructure

- Configuration Management Defined
  - Software Configuration Management (SCM) Processes
  - SCM Plans
1. Configuration Management Team
    - Organizational-Level SCM Group
    - Project-Level SCM Group
    - SCM Roles
  2. Configuration Management Tools
    - SCM Tools
    - Evaluating SCM Tools
  3. Library Processes
    - Library Functions
    - SCM Library Types
    - SCM Library Processes – Creating a New Work Product
    - SCM Library Processes – Creating an Official Software Build
    - SCM Library Processes – Testing a Build
    - SCM Library Processes – Modifying a Controlled Work Product
    - SCM Library Processes – Branching
    - SCM Library Processes – Merging

### B. Configuration Identification

1. Configuration Items
  - Configuration Identification Activities
  - Types of Work Product Control
  - Software Work Product Hierarchy
  - Factors that Guide Software Product Partitioning
  - SCM Risk Indicators
  - Identifying Configuration Items
  - Acquisition
  - Identification Methods

- Constituent Configuration Item Identification Scheme – Example
- Build Identification Scheme – Example
- Document Identification Scheme – Example

### 2. Software Builds & Baselines

- Software Builds
- Principles of Build Engineering
- Controlling Builds
- Build Reproducibility
- Baseline Defined
- Classic Types of Baselines
- Agile Baselines

### C. Configuration Control & Status Accounting

#### 1. Item, Baseline & Version Control

- Configuration Control
- Configuration Control Procedures
- Software Configuration Management Balance
- SCM Throughout the Product's Life Cycle
- Controlling Software Work Products
- Change Control Process
- Tracking Item Change
- Versions, Revisions & Releases
- Version Control
- Configuration Item Dependencies

#### 2. Configuration Control Boards

- Configuration Control Boards (CCB)
- CCB Membership
- CCB Roles & Responsibilities
- CCB Charter
- CCB Process
- Impact Analysis
- Backward Traceability & Impact Analysis
- Forward Traceability & Impact Analysis
- Multiple Levels of CCBs

#### 3. Concurrent Development

- Concurrent Development
- Impact Analysis & Concurrent Development
- Supporting Multiple Versions

#### 4. Status Accounting

- Status Accounting
- SCM Data
- Change Requests
- Status Reporting

### D. Configuration Audits

- Configuration Audits & Reviews
- Functional Configuration Audit (FCA)
- Physical Configuration Audit (PCA)

### E. Release & Distribution Issues

#### 1. Product Release

- Features vs. Corrective Releases
- Release Management Planning & Scheduling
- Release Propagation Planning & Scheduling

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- Version Description Document (VDD)
  - Hardware & Software Dependencies
2. Customer Deliverables
- Software Deliverables
  - V&V of Customer Deliverables
  - Packaging
  - Packaging Concerns
  - Patching
  - Releasing a Build
  - Production
  - Delivery Vehicles
  - More Deliverable V&V
  - Release Support
3. Archival Processes
- Backups
  - SCM Library Processes – Backup
  - Archives
  - Backups vs. Archives
  - Asset Retrieval
  - Retention of Historic Records

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