
Course Title: Advanced Problem-Solving & Root Cause Analysis

Duration: 5 Days (approximately 35-40 instructional hours)

Course Goal: To equip operations, quality, and engineering professionals with an advanced toolkit of analytical methods to precisely define complex problems, rigorously analyze their root causes, and implement sustainable, data-validated solutions.

Core Focus: Moving beyond basic brainstorming to a systematic, evidence-based problem-solving discipline. The course emphasizes quantifying the problem and statistically validating the root cause before committing resources to a solution.

Learning Objectives:

Upon successful completion of this workshop, participants will be able to:

- Apply the DMAIC (Define, Measure, Analyze, Improve, Control) framework to any complex problem.
- Develop a clear, measurable, and scoped Problem Statement and Project Charter.
- Map complex processes using tools like SIPOC and detailed process flowcharts to identify potential failure points.
- Use basic Statistical Process Control (SPC) charts to differentiate between common and special cause variation.
- Generate a comprehensive list of potential causes using structured brainstorming and Fishbone (Ishikawa) diagrams.
- Drill down to the true root cause using techniques like the "5 Whys" and Pareto Analysis.
- Use data and basic hypothesis testing (e.g., t-tests, ANOVA) to statistically validate cause-and-effect relationships.
- Develop, prioritize, and select optimal solutions using an Effort vs. Impact matrix.
- Create a robust Control Plan to ensure problems do not recur.
- Understand and apply Failure Mode and Effects Analysis (FMEA) as a proactive prevention tool.
- Lead a problem-solving team through this entire structured process.

Target Audience:

- **Engineers** (Process, Quality, Manufacturing, Software).
- **Operations Managers and Supervisors.**
- **Quality Assurance (QA) Professionals and Auditors.**
- **Lean and Six Sigma Practitioners.**
- **Senior Data Analysts and Project Managers** tasked with leading improvement initiatives.

Prerequisites:

- Professional experience in an operational, technical, or quality-focused role.
- An analytical mindset and comfort working with data.
- Proficiency with Microsoft Excel. Experience with statistical software (like Minitab or JMP) is a plus but not required.

Teaching Methodology:

This is a rigorous, hands-on, problem-solving clinic.

- **Framework-Driven:** The DMAIC model provides a clear, logical spine for the entire week.
- **Intensive Case Study:** A single, complex case study (e.g., "A medical device company is experiencing a high rate of product field failures") will be used for all workshops, allowing for a deep, progressive analysis.
- **Statistical Thinking, Not Just Math:** The course focuses on the practical application and interpretation of statistical tools to answer business questions, not on the complex formulas.
- **Tool-Based Labs:** Participants will use Excel and, if available, statistical software to perform real analysis on the case study data.
- **Facilitated Workshops:** A significant amount of time is dedicated to group work where participants apply tools like the Fishbone Diagram and FMEA to the case study, simulating a real problem-solving team meeting.

Materials Provided:

- The "Advanced Problem-Solver's Toolkit," including templates for:

- Project Charter
- SIPOC Diagram
- Fishbone Diagram
- FMEA Worksheet
- A3 Problem-Solving Report
- All datasets, case study materials, and lab files.
- A guide to interpreting statistical outputs.
- Certificate of Completion.

Detailed Day-by-Day Curriculum

Day 1: DEFINE - Framing the Problem with Precision

- **Module 1: The Anatomy of a Problem (Approx. 2 hours)**
 - Welcome, introductions, and course objectives.
 - Symptom vs. Problem vs. Root Cause: The critical distinctions.
 - Introduction to the DMAIC framework as a structured problem-solving roadmap.
- **Module 2: Defining and Scoping the Problem (Approx. 3 hours)**
 - Developing a crystal-clear Problem Statement (SMART criteria).
 - The Project Charter: Aligning the team on goals, scope, and resources.
 - Voice of the Customer (VOC) and defining Critical-to-Quality (CTQ) characteristics.
 - **Workshop:** Draft a complete Project Charter for the case study problem.
- **Module 3: Mapping the Process (Approx. 2.5 hours)**
 - High-Level Mapping with SIPOC (Suppliers, Inputs, Process, Outputs, Customers).
 - Creating detailed process flowcharts to visualize handoffs and decision points.
 - **Workshop:** Develop a SIPOC and a high-level process map for the case study.

Day 2: MEASURE - Quantifying the Problem's Magnitude

- **Module 4: Developing a Data Collection Plan (Approx. 2 hours)**
 - What data do you need to measure the problem and potential causes?
 - Operational definitions: Ensuring everyone measures the same way.
 - Basics of measurement system analysis (Gage R&R) - conceptual overview.
- **Module 5: Understanding Variation with SPC (Approx. 3.5 hours)**
 - The foundation of quality: Common Cause vs. Special Cause variation.
 - Introduction to Control Charts (X-bar & R, p-charts).
 - How to use Control Charts to establish a performance baseline and detect signals of change.
 - **Lab:** Create and interpret a Control Chart using the case study data in Excel/Minitab.
- **Module 6: Assessing Process Capability (Approx. 2 hours)**
 - Is your process even capable of meeting specifications?
 - Understanding Cp and Cpk as measures of process potential and performance.
 - **Lab:** Calculate and interpret the process capability for the case study.

Day 3: ANALYZE - The Systematic Hunt for the Root Cause

- **Module 7: Generating Potential Causes (The "Fishbone") (Approx. 3 hours)**
 - Structured Brainstorming Techniques.

- The Fishbone (Ishikawa) Diagram: A deep dive into the 6M categories (Man, Machine, Method, Material, Measurement, Mother Nature/Environment).
- **Workshop:** Lead a facilitated session to build a comprehensive Fishbone Diagram for the case study.
- **Module 8: Prioritizing and Drilling Down (Approx. 4 hours)**
 - The Pareto Principle (80/20 Rule): Using Pareto charts to focus on the "vital few" causes.
 - The "5 Whys" Technique: A structured method for drilling down from a symptom to a true root cause.
 - **Workshop:** Create a Pareto chart from defect data. Then, take the top bar from the chart and conduct a rigorous "5 Whys" analysis.

Day 4: ANALYZE with Data & Develop Solutions

- **Module 9: Validating Root Causes with Data (Approx. 4 hours)**
 - Moving from "I think" to "I have proven."
 - The logic of hypothesis testing explained for non-statisticians.
 - Practical Application:
 - Using **t-tests** to compare two groups (e.g., "Is Supplier A's material stronger than Supplier B's?").
 - Using **ANOVA** to compare more than two groups (e.g., "Is there a significant difference in defects across three different shifts?").
 - **Lab:** Use Excel/Minitab to run a hypothesis test to validate a potential root cause from the case study.
- **Module 10: Generating and Selecting Solutions (Approx. 3 hours)**
 - Brainstorming solutions that directly address the *validated* root cause.
 - The Effort vs. Impact Matrix: A simple and powerful tool for prioritizing solutions.
 - The Pugh Matrix: A more rigorous method for solution selection.
 - **Workshop:** Generate and prioritize potential solutions for the case study using an Effort/Impact matrix.

Day 5: IMPROVE & CONTROL - Implementing and Sustaining the Fix

- **Module 11: Piloting and Implementation (Approx. 2.5 hours)**
 - The Plan-Do-Check-Act (PDCA) cycle for testing your solution on a small scale.
 - Developing an implementation plan: tasks, timelines, and responsibilities.
 - The importance of communication and change management.
- **Module 12: The Control Plan: Making the Gains Stick (Approx. 3 hours)**
 - How to ensure the problem never returns.
 - Updating documentation, procedures, and training.
 - Using the SPC charts from the Measure phase to monitor the new, improved process.
 - **Proactive Prevention:** Introduction to Failure Mode and Effects Analysis (FMEA) to anticipate future problems.
 - **Workshop:** Develop a Control Plan and a mini-FMEA for the implemented solution in the case study.
- **Module 13: Capstone: The A3 Report (Approx. 2 hours)**
 - **Final Project:** Participants will synthesize their entire week's work into a single-page A3 Problem-Solving Report. This report tells the complete story from problem definition to the control plan.
 - Groups will present their A3 report to the class.
- **Course Wrap-up and Final Q&A (Approx. 0.5 hours)**