D. QUALITY ASSURANCE

D1. Define Quality in Manufacturing and Explain Importance

D1.1. Understand goals for quality application.

Performance Objective: After clarifying mission statements, the student will be able to identify a variety of goals that need to be achieved and give reasons why the proposed process plan should enable the goals to be achieved.

D1.2. Contrast Quality In manufacturing systems with other manufacturing quality control methods.

Performance Objective: After studying different manufacturing systems, the student will be able to compare and contrast at least eight differences between Quality In manufacturing and other approaches to manufacturing.

MANUFACTURING DIFFERENCES	
QUALITY IN VS OTHER QUALITY CONTROL	
Continuous process analysis	End product inspection
Statistical Process Control (SPC)	Rework, scrap, waste
Employee empowerment	Authority and decisions top-down
Customer-in design and development	Customer complaints
Just-in-time delivery	Warehousing
Problem-solving process	Job/task description
Cross-functional teams	Supervisor/employee relationship
Build partnerships	Work in isolation
Use employee knowledge and creativity	Management decisions
Focused employee training	

D1.3. Justify the use of a Quality In control method.

Performance Objective: After discussing the differences between "Quality In" and other manufacturing systems, the student will be able to give at least six reasons for choosing "Quality *I*n" control methods.

BENEFITS OF QUALITY IN CONTROL METHOD	
Saving from reduction of rework, scrap, and waste	Better supplier communications Just-in-time delivery
Employees inspect own work	Better customer responsiveness
Eliminate cost of inspectors	Front-line responsibility
Better-trained employees	

D1.4. Identify influence of a Quality In manufacturing system on specific manufacturing processes.

Performance Objective: Given a sample product and related manufacturing processes, the student will be able to analyze the system, break it down into essential processes, and state how the principles of "Quality In" manufacturing can be applied to each.

D2. Understand Concept of How Quality can Improve Profit

D2.1. Explain how manufacturing costs are determined.

Performance Objective: The student will be able to list at least twelve factors that influence the cost of manufacturing.

MANUFACTURING COST FACTORS	
Materials	Heating, lighting, ventilation
Labor	Planning
Tooling	Inspection
Capital assets	Design
buildings and equipment	Engineering
Consumable assets	Medical/dental coverage
Management	Workman compensation
Training	Other insurance
Legal counsel	Regulatory compliance
Research and development	Taxes

D2.2. Explain how profit is generated.

Performance Objective: After studying the basic business process and given an income and expense statement, the student will be able to calculate the net profits of a hypothetical company.

Performance Objective: The student will be able to identify the major factors that affect profit in a manufacturing company.

D2.3. Explain the effects of quality on profit.

Performance Objective: Accepting that profits are the result of sales minus costs, the student will be able to state how "Quality in" can diminish costs, increase customer satisfaction, and, therefore, increase profits.

Effects of Quality	
Customer satisfaction	Material costs diminish
Customer responsiveness	Labor costs diminish
Business reputation/integrity	Meet or exceed customers' expectations

D3. Apply Principles and Tools of Continuous Quality Improvement

D3.1. Identify the effects of quality improvement programs.

Performance Objective: After studying the principles and effects of various quality improvement programs (CQI, TQM, TQC, Operations Excellence), the student will be able to state how these effects may be observed in a manufacturing process.

QUALITY IMPROVEMENT PROGRAM EFFECTS	
Customer responsiveness	Root-cause solutions
Process analysis and improvement; maintain or create competitive edge	Cost savings from Waste elimination Rework elimination Excessive scrap elimination
Inspect-in quality	Pride in workmanship
Create hard data - not opinions	Generate vertical and horizontal communications
Utilize employees' knowledge and skills	Cross-functional teams
Generate creative thinking	Problem-solving process applied

D3.2. Demonstrate the ability to apply continuous quality improvement techniques to manufacturing processes.

Performance Objective: Working on a quality improvement team, given problem-solving and continuous quality improvement tools, and using student-manufactured parts, the student(s) will be able to identify areas of possible waste, identify data-gathering points, record variance in the parts, and use problem-solving tools to suggest at least five possible improvements.

PROBLEM-SOLVING TOOLS	
1. Identify problem situation	6. Select best tentative solution
2. Gather data	7. Test selected solution
3. Define problem	8. Evaluate test data
4. Identify possible causes	9. Implement solution in the process
5. Identify hypotheses (possible solutions)	

DATA ANALYSIS/PRESENTATION TOOLS		
Process flowchart	Pareto analysis	Histograms
Control charts	Scatter diagram	Cause and effect diagram
Loss function analysis		Fishbone Lotus diagram

D3.3. Integrate improvement processes.

Performance Objective: Given the ability to flowchart a process, the student will be able to gather data, chart this process daily, and suggest and implement improvements on a continuous basis.

D4. Understand and Apply Statistical Process Control (SPC) to Monitor Production Process

D4.1. Define SPC

Performance Objective: After studying basic Statistical Process Control principles and problem-solving tools, the student will be able to state the purpose of SPC and discuss seven different statistical tools.

BASIC STATISTICAL CONCEPTS AND TOOLS	
Sampling and populations	Control charts such as
Average, median, and mean	Histograms
Range, standard deviation	Scatter plots
Design of experiments	Variations in the process capability
Variable factors	Standard error
Suboptimization	Replication
Root cause	Control limits
Regression	Common cause

D4.2. Identify the relationship between SPC steps and specific production processes.

Performance Objective: Given the basic steps in applying Statistic Process Control and a flowchart of a production process for a particular part, the student will be able to discuss how the SPC steps relate to the production process.

SPC PROBLEM-SOLVING STEPS	
1. Identify potential problems by:	5. Select most promising hypothesis
1.1 Customer interviews (internal and external)	6. Implement a test
1.2 Flowchart analysis	7. Analyze test results
2. Gather data	8. Implement results in the system
3. Analyze data	9. Monitor the implementation
4. Generate tentative hypotheses	10. Maintain an on-going evaluation process

D4.3. Apply SPC to specific production processes.

Performance Objective: Using blueprints/customer specifications, available measurement tools, and sample parts from a production process, the student will be able to write an inspection plan to identify variance in the process and establish control limits.

D5. Evaluate Data to Monitor Production Processes to Customer Satisfaction

D5.1. Analyze production specific processes.

Performance Objective: Given customer specifications and a sample manufacturing process composed of at least ten steps, the student will be able to generate a flowchart of the process, identify areas or steps that are nonvalue added, and identify process steps where data should be gathered for problem clarification.

D5.2. Analyze and interpret test data for compliance to specifications.

Performance Objective: Given customer part specifications, technical drawings, process inspection data, and sample product, the student will be able to analyze and interpret the data, determine a need, and give reasons for a change in the process in a 5 to 10 minute oral presentation.

D5.3. Correct production process (if indicated by analysis of the data).

Performance Objective: Using the analysis and interpretation of data generated with SPC tools, the student will be able to generate hypotheses that have the potential to identify and eliminate the root cause of the problem and implement changes.

D5.4. Monitor process improvement.

Performance Objective: Given successful test data, necessary tools, and instructions for process improvement, the student will be able to implement the improvement changes and to demonstrate assurance that the process is maintained within the improvement requirements.

D6. Analyze Consumer Problems Caused by Manufacturing and Recommend Solution

D6.1. Identify customer problems.

Performance Objective: Using a variety of communication tools and a systematic analysis of the data gathered, the student will be able to recommend a solution to address the customer's problem.

CUSTOMER COMMUNICATION TOOLS	
Customer design-in	Specifications
Interviews	Checklists
Surveys	Questionnaires

CUSTOMER SATISFACTION ANALYSIS	
1. Identify customer needs and expectations	6. Prototype analysis
2. Clarify needs and expectations	7. Analyze data/performance
3. Clarify standards/specifications	8. Determine relative importance of features
4. Collect data	9. Evaluate and improve effectiveness
5. Identify roles and responsibilities	10. Follow-up

D6.2. Classify customer problems.

Performance Objective: Given an array of 50 customer complaints regarding a particular product, the student will be able to use data analysis presentation tools to categorize and display the findings.

D6.3. Determine causes of the problem.

Performance Objective: Using data gathered from customer surveys and basic statistical processes and tools, the student will be able to use a variety of data presentation tools to isolate root causes.

DATA ANALYSIS/PRESENTATION TOOLS		
Process flowchart	Pareto analysis	Histograms/bar chart
Run charts	Scatter diagram	Cause and effect diagram
Control charts; loss function analysis		Fishbone chart Lotus diagram

D6.4. Apply problem-solving skills and tools.

Performance Objective: Given the basic steps in the problem-solving process and a flowchart/analysis of a production process, the student will be able to apply problem-solving skills and tools to identify the possible problems and suggest tentative solutions.

PROBLEM-SOLVING SKILLS AND TOOLS	
1. Identify problem situation	6. Select best tentative solution
2. Gather data	7. Test selected solution
3. Define problem	8. Evaluate test data
4. Identify possible causes	9. Implement solution in the process
5. Identify hypotheses (possible solutions)	

D6.5. Recommend possible solutions.

Performance Objective: Having successfully completed a problem-solving process that generated a variety of possible solutions, the student will be able to analyze the different potential solutions and recommend the one most likely to succeed.

COST VARIABLE IN SUCCESSFUL SOLUTIONS	
Technology	Time to complete
Man power	Management support
Capital resources	Return on investment
Customer priorities/satisfaction	

D7. Establish Methods, Plans, and Procedures to Maintain Quality

D7.1. Develop a plan utilizing a selected quality control system.

Performance Objective: After studying quality control systems, the student will be able to outline and discuss a plan to achieve continuous quality improvement.

ELEMENTS OF A QUALITY IMPROVEMENT PLAN	
Internal shared mission and vision	Reward implementation
Teamwork	Customer-in
Leadership	SPC
Reward customer satisfaction	Training in all of these areas
Problem-solving processes (CQM, TQM, etc.)	Performance assessment based on these areas
Current technology	