CONCEPT

AI for Quality Control: Visual Inspection and Predictive Quality Analytics

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Introduction:

AI for quality control promises fewer escapes, less scrap and faster defect diagnosis, yet many plants still rely on tired manual inspectors and quality reports that arrive after the batch has shipped. Inspection images, MES records and historian tags sit in separate systems, defect labels are inconsistent and nobody knows how to prove a model is fit to reject parts. This Core Concept course prepares quality and production managers to select, validate and govern visual inspection and predictive quality models without writing code. Participants leave with an AI Quality Use Case Roadmap.

Course Objectives:

- Map product and process quality problems to AI use cases such as visual defect detection, process anomaly detection and scrap or rework prediction
- Assemble a quality dataset by linking MES genealogy, historian process tags and inspection results at batch, lot or serial level
- Specify a camera, lighting and image labelling plan for a deep learning visual inspection station on a no-code platform
- Interpret predictive quality and root-cause analytics outputs to decide which process parameters to adjust or tighten
- Validate an inspection or prediction model on the shop floor using escape rate, false reject rate and agreement with human inspectors
- Produce an AI Quality Use Case Roadmap with a prioritised pilot, human-in-the-loop decision rules and a cost of poor quality case

Target Audience:

- Quality managers accountable for defect escapes, customer complaints and cost of poor quality
- Quality and process engineering leads who own inspection plans, control plans and defect investigations
- Production managers responsible for yield, scrap, rework and first-pass quality on the line
- Manufacturing digital and Industry 4.0 leads who sponsor analytics and vision projects in the plant
- Manufacturing data and MES owners who manage production records, genealogy and quality data flows

Course Outline:

Day 1: Quality Problems Suited to AI and Current-State Assessment

- Cost of Poor Quality Breakdown: Scrap, Rework, Escapes and Warranty Returns
- Rule-Based Machine Vision Versus Deep Learning Defect Classification
- Quality Use Case Taxonomy: Detect, Predict, Diagnose and Prescribe
- Inspection Pain Point Mapping Across Incoming, In-Process and Final Inspection
- AI Quality Readiness Assessment for Data, Inspectors and Line Systems

Day 2: Manufacturing Data Architecture and Visual Inspection Systems

- ANSI/ISA-95 Functional Levels: Where MES, Historians and ERP Hold Quality Data
- Linking MES Genealogy, Historian Tags and Test Results by Lot or Serial Number
- Vision Station Design: Cameras, Lenses, Lighting and Part Presentation
- Automated Optical Inspection Defect Classes: Missing, Misplaced, Bridged and Damaged Features
- Edge Inference Versus Cloud Training Architecture for Inspection Models

Day 3: Building Inspection and Predictive Quality Models Without Code

- Defect Image Labelling Guide: Classes, Bounding Boxes and Reviewer Agreement
- No-Code Vision Platform Workflow: Upload, Label, Train and Test
- Unsupervised Anomaly Detection on Process Tags When Defect Labels Are Scarce
- Scrap and Rework Prediction from Process Parameters Using AutoML Tools
- Feature Importance Charts for AI-Assisted Root-Cause Hypotheses

Day 4: Shop-Floor Validation, Human Oversight and AI-Enhanced SPC

- Confusion Matrix for Inspection: Escape Rate Versus False Reject Rate Trade-Off
- Golden Sample Sets and Side-by-Side Trials Against Human Inspectors
- Human-in-the-Loop Review Queues and Operator Override Rules
- Multivariate Anomaly Scores Alongside Control Charts for Early Process Drift
- Model Drift Triggers After New Suppliers, Tooling or Product Variants

Day 5: Case Work and the AI Quality Use Case Roadmap

- Electronics Assembly Case: Reviewing a Vision System's Rejected-Part Images
- Food and Plastics Moulding Cases: Linking Process Settings to Scrap Batches
- Use Case Prioritisation Matrix Scored on Value, Data Readiness and Risk
- AI Quality Use Case Roadmap Drafting with Pilot Scope and Acceptance Criteria
- Roadmap Presentation and Peer Challenge Panel

Skills You Will Gain:

- Quality Use Case Scoping
- Manufacturing Data Integration
- Vision Inspection Specification
- Defect Image Labelling
- Predictive Quality Interpretation
- Inspection Model Validation
- Human-in-the-Loop Design
- Cost of Poor Quality Modelling

Why Attend This Course:

- Return with an AI Quality Use Case Roadmap for a real line, product or inspection station
- Question vision and analytics vendors on labelling effort, false rejects and how their model behaves on new product variants
- Stop running pilots that detect defects in the lab but never earn the trust of inspectors and line supervisors
- Compare inspection and quality analytics practice with peers from electronics, automotive parts, food, packaging and process industries

Conclusion:

AI adds value to quality control only when clean, linked production data, well-labelled defect images and disciplined validation come together with inspectors who trust the output. The course moves from the cost of poor quality and use case selection, through ISA-95 data layers and vision station design, to no-code model building, anomaly detection and predictive quality, and then to shop-floor validation, human oversight and drift control. The final day applies these methods to multi-sector cases and produces an AI Quality Use Case Roadmap ready for sponsor review.