NAAN MUDHALVAN PROJECT

PHASE-2

INNOVATION AND PROBLEM SOLVING

TITLE : QUALITY CONTROL IN MANUFACTURING

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INNOVATION AND PROBLEM SOLVING

INNOVATION IN PROBLEM SOLVING :

The objective of this phase is to reduce surface defects (scratches, dents, and paint inconsistencies) in metal car body panels to below 1%, using a data-driven approach. This will be achieved by analyzing the entire production process and implementing intelligent quality monitoring and control systems.

CORE PROBLEMS TO SOLVE :

1. Tooling Wear & Maintenance Gaps: Undetected wear contributes to defect variability.
2. Handling Errors: Manual errors during transfer and assembly stages cause damage.
3. Paint Booth Inconsistencies: Variations in temperature, humidity, and spray alignment affect paint quality.
4. Limited Root Cause Traceability: Current quality checks do not pinpoint defect origins efficiently.

INNOVATIVE SOLUTIONS PROCESSED :

1. Real-Time Statistical Process Control (SPC)

OVERVIEW: Integrate SPC at each major production stage to detect and flag deviations in real-time.
INNOVATION: Use machine learning models to recognize non-obvious patterns in defect trends.
TECHNICAL ASPECTS :

- Sensor-driven data collection across tools and stages
- SPC charts with dynamic control limits
- Root causes prediction using pattern analysis

2. Vision-Based Defect Detection Systems

OVERVIEW: Install AI-powered cameras to detect surface anomalies inline.
INNOVATION: Deep learning models trained to identify even subtle variations in panel surfaces.
TECHNICAL ASPECTS :

- Computer vision with CNN (Convolutional Neural Networks)
- Real-time alerts for operator intervention
- Data logs for traceability

3. Digital Twin of Paint Booth

OVERVIEW: Create a digital simulation of the paint booth environment to simulate and optimize conditions.

INNOVATION: Predictive adjustments based on live environmental data.

TECHNICAL ASPECTS :

- IoT-enabled temperature/humidity sensors
- Feedback control for spray parameters
- Simulation models for predictive maintenance

4. Integrated Root Cause Analytics Dashboard

OVERVIEW: Consolidate defect data with equipment, handling, and environment logs for diagnostic insights.

INNOVATION: A single interface for quality managers to explore cross-functional insights.

TECHNICAL ASPECTS :

- BI dashboard tools with anomaly clustering
- Drill-down filters for tool, shift, operator, and material
- Historical trend mapping

IMPLEMENTATION STRATEGY :

1. Data Infrastructure Setup: Deploy IoT sensors, vision systems, and integrate existing machines with SPC software.

2. Model Training & Testing: Train AI models with historical defect data and validate using pilot runs.

3. Feedback Loop Creation: Implement regular quality review sessions to refine models and process settings.

CHALLENGES AND SOLUTIONS :

- Resistance to Change: Conduct operator training and demonstrate defect rate improvements in pilot areas.

- Data Overload: Use edge computing to filter and preprocess data before cloud analysis.

- Integration Complexity: Phase-wise deployment to minimize disruption.

EXPECTED OUTPUTS :

1. Defect Rate Reduction: Targeting below 1% defect rate through early detection and prevention.

2. Improved Process Transparency: Root cause traceability reduces downtime and rework.

3. Operator Empowerment: Real-time feedback enables faster corrective action.

4. Customer Satisfaction: Higher quality panels enhance brand reliability.

NEXT STEPS :

1. Pilot Implementation: Test system on one production line over 4–6 weeks.

2. KPI Monitoring: Track defect rates, downtime, and rework trends.

3. Rollout Plan: Scale to all lines after successful pilot, with continuous improvement loops.