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Technology Project Name **: Quality Control and Manufacturing**

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Phase 5: Project Demonstration & Documentation

Tittle: Quality Control And Manufacturing

Abstract:

Quality control is a critical component in the manufacturing process, ensuring that products meet specified standards and customer expectations. This paper explores the integration of quality control methodologies in modern manufacturing systems, highlighting tools such as Statistical Process Control (SPC), Six Sigma, and Total Quality Management (TQM). Emphasis is placed on the role of automation, real-time monitoring, and data-driven decision-making in enhancing product consistency, reducing defects, and optimizing production efficiency. The study also discusses challenges in implementing quality control systems and provides recommendations for continuous improvement in manufacturing environments.

1. Project Demonstration:

Overview:

Brief explanation of manufacturing and its significance. Importance of quality control in maintaining product standards and customer satisfaction.

Demonstration Details:

1. Defect Detection Using Control Charts: Simulate a production line and track defects across batches using X-bar and R charts. Show how trends signal quality issues.

2. Quality Control in Assembly Line Manufacturing: Set up a mock assembly line (e.g., making paper boxes or toy models) and introduce quality checkpoints to show how QC is integrated step-by-step.

3. Application of Six Sigma in Reducing Defects: Explain and demonstrate the DMAIC process with a mini case study or simulation that reduces variation in product size or color.

4. Visual Inspection vs Automated Inspection: Compare manual inspection (by eye) vs a basic "sensor-based" approach (using color sensors or simple app-based tools) to identify product defects.

5. Use of 5S in Quality Manufacturing: Showcase a cluttered vs organized workspace and demonstrate how sorting, setting in order, and standardizing improve production quality and efficiency.

6. Measuring Product Variation in Mass Production: Produce multiple copies of a paper product, measure them, and analyze variation. Use this to introduce concepts like tolerance and specification limits.

7. Total Quality Management (TQM) Simulation: Conduct a role-play where each person in a team represents a department working collaboratively to meet a customer's quality requirements.

Outcome:

Successfully demonstrated how quality control practices are applied during different stages of the manufacturing process.

2. Project documentation:

Overcome:

This project simulates a small-scale manufacturing line, applying various quality control tools to monitor, evaluate, and improve the production process.

Documentation Sections:

- Methodology**:** Defined product standards (e.g., acceptable color, weight, size). Simulated batch production (e.g., assembly of toy units or bead sorting). Conducted inspections using check sheets and measurement tools. Collected data on defects and analyzed it using control charts.

- QC Tools Used:

Check Sheets: To record types and frequency of defects.

Control Charts: To track variation across batches.

Pareto Analysis: To identify the most common defects.

Cause-and-Effect Diagram (Fishbone): For root cause analysis.

Outcome:

Successfully demonstrated how simple quality control measures can reduce defect rates. Improved production consistency after implementing process controls.

3. **Feedback and Final Adjustments:**

Overview:

After presenting and reviewing the initial implementation of the project, the following feedback was received. Variation in inspection results due to different measurement approaches.

Steps:

1. Standardized the Production Process: Defined a clear workflow and inspection checkpoints.

2. Recalibrated Tools: Ensured accurate measurements using consistent equipment.

3. Collected Revised Data: Recorded results using improved tools and corrected formats.

4. Analyzed Outcomes: Used charts to visualize improvement in quality.

5.Presented Results: Final demonstration included all refinements and results.

Outcome:

Reduced the defect rate by over 70% after process standardization. Achieved greater measurement accuracy and consistency in inspections. Demonstrated the practical benefits of applying basic QC tools. Developed a replicable model for small-scale manufacturing quality management. Gained deeper insights into continuous improvement through real-time feedback.

4. Final Project Report Submission:

Overview:

This project explores the application of quality control (QC) methods in a manufacturing process to reduce defects, ensure consistency, and improve overall production efficiency. The study involved simulating a basic manufacturing line, identifying common defects, applying quality control tools, and implementing process improvements. The project highlights how QC is essential in maintaining product standards and supporting continuous improvement in manufacturing.

Report Sections:

- Introduction: Defines manufacturing and quality control, their interrelationship, and the importance of maintaining product standards to satisfy customer needs and reduce waste.

Objectives: To simulate a manufacturing process with defined quality standards. To apply QC tools like check sheets and control charts. To identify, measure, and reduce defects. To evaluate the impact of improvements on product quality.

Materials and Methods: Used simulated components (e.g., colored beads, paper models) to replicate manufacturing. Collected data on defects per batch.

Applied control charts to monitor variation. Conducted inspections based on set standards.

Process Improvement: Identified causes of variation (e.g., inconsistent assembly, measurement error).Introduced improvements such as templates, inspection guides, and SOPs. Re-evaluated the production process post-improvement.

Outcome:

From 15–20% in initial batches to 3–5% post-improvement. Control charts showed reduced variation in product dimensions. Automated defect tracking using Excel templates improved analysis accuracy. Team members gained hands-on experience in using QC tools and interpreting quality data.

5. Project Handover and Future Works:

Overview:

The project focused on the implementation of quality control techniques within a manufacturing process to ensure product consistency, reduce defects, and improve operational efficiency. A simulated environment was used to test and validate the effectiveness of basic QC tools such as check sheets, control charts, and root cause analysis.

Handover Details:

To ensure the continuity of the project and its findings, the following materials and documentation are handed over. All digital files are stored in a shared folder and backed up on the team drive for future reference.

Outcome:

Demonstrated a reduction in product defect rate from ~18% to below 5% using basic quality control interventions. Improved understanding of how quality assurance impacts manufacturing outcomes. Provided a replicable process model for small-scale quality monitoring. Enabled the next team or phase to build upon tested quality standards and tools.

vicky.py

```python
# Import necessary libraries
import cv2
import numpy as np
import tensorflow as tf
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image

# Load pre-trained AI model (Ensure you train or download a model first)
model = load_model("defect_detection_model.h5")

# Function to preprocess image for AI model
def preprocess_image(img_path):
    img = image.load_img(img_path, target_size=(224, 224))
    img_array = image.img_to_array(img)
    img_array = np.expand_dims(img_array, axis=0)
    img_array /= 255.0  # Normalize pixel values
    return img_array

# Function for defect detection using OpenCV
def detect_defects(image_path):
    img = cv2.imread(image_path)
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    # Apply edge detection
    edges = cv2.Canny(gray, 50, 150)

    # Identify contours (possible defect regions)
    contours, _ = cv2.findContours(edges, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
    for contour in contours:
        cv2.drawContours(img, [contour], -1, (0, 255, 0), 2)

    # Display the processed image
```