**Predictive Maintenance Dashboard for CNC Machines**

**Objective:**

This dashboard aims to monitor and predict failures in CNC machines, providing actionable insights to reduce downtime and optimize machine performance. It integrates various parameters such as predicted failure rates, vibration levels, operational hours, and temperature metrics.

**Key Features of the Dashboard:**

**1. Predicted Failures by Quarter, Month, and Day**

* **Purpose:** Visualizes the trend of predicted failures over a selected period.
* **Insights:** Identifies periods with a high likelihood of machine failures, aiding in proactive maintenance planning.

**2. Vibration Level vs. Spindle Speed (RPM)**

* **Purpose:** Analyzes the relationship between vibration levels and spindle speed for machines with predicted failures.
* **Insights:** Helps determine whether high vibration levels or specific spindle speed ranges contribute to failures.

**3. Predicted Failure Breakdown (Pie Chart)**

* **Purpose:** Displays the proportion of machines with and without predicted failures.
* **Insights:** Provides an at-a-glance view of overall machine health, allowing teams to focus on problematic machines.

**4. Rejection Rate by Operation Hours**

* **Purpose:** Plots rejection rates against machine operation hours.
* **Insights:** Correlates high rejection rates with specific operation durations, guiding quality control efforts.

**5. Predicted Failure by Temperature**

* **Purpose:** Examines the impact of operating temperature on failure rates.
* **Insights:** Identifies critical temperature ranges to avoid for optimal machine performance.

**6. Top 5 High-Risk Machines**

* **Table Columns:**
  + **Machine ID:** Identifier for high-risk machines.
  + **Rejection Rate:** Indicates performance efficiency.
  + **Days Left for Maintenance:** Predicts remaining days before maintenance is due.
  + **Sum of Days After Maintenance:** Tracks maintenance cycles.
  + **Predicted Failure:** Highlights machines likely to fail soon.
* **Purpose:** Prioritizes high-risk machines for immediate attention.

**7. Average Metrics**

* **Average Temperature (°C):** Displays the average operating temperature for monitored machines.
* **Average Spindle Speed (RPM):** Shows the average spindle speed for the fleet.
* **Purpose:** Provides aggregated metrics for quick assessment of machine conditions.

**Filters and Interactivity:**

* **Filters:**
  + Failure Type
  + Issue Resolved By
  + Maintenance Type
  + Date
  + Production Quality (High, Medium, Low)
* **Purpose:** Enables dynamic filtering to focus on specific machine types, timeframes, and performance quality levels.

**Key Insights:**

1. **High Vibration Levels and Spindle Speeds:** Machines with high vibration levels tend to show increased failure likelihood.
2. **Temperature's Impact:** Higher operating temperatures correlate with increased failure rates.
3. **Proactive Maintenance:** The "Top 5 High-Risk Machines" table provides actionable insights to prioritize maintenance and reduce downtime.

**Recommendations:**

1. **Temperature Control:** Implement cooling systems or adjust operations to maintain optimal temperature ranges.
2. **Vibration Monitoring:** Use sensors to continuously monitor and mitigate high vibration levels.
3. **Maintenance Scheduling:** Use the "Days Left for Maintenance" metric to plan proactive servicing of high-risk machines.
4. **Quality Control:** Investigate and address causes of high rejection rates during prolonged operation hours.