**Introduction**

In today’s manufacturing industry, achieving operational efficiency and maintaining high-quality products are essential for success. However, the vast amount of sensor data and machine status information makes it difficult to manually track performance trends and detect issues. This is where data analytics proves invaluable.

By analyzing data from machine sensors, status logs, and quality checks, we can obtain crucial insights into production line performance. These insights enable decision-makers to enhance machine utilization, identify sensor anomalies, and improve quality control measures, ultimately fostering more efficient and dependable manufacturing processes.

**Problem statement**

A manufacturing company that produce mechanical tools such as bolts, nuts and others, the manufacturing process involves monitoring various sensor readings, machine statuses (On, Off, Standby), and quality checks to ensure optimal production efficiency and product quality. However, inconsistencies in sensor data and machine operation can lead to inefficiencies, product defects, and unexpected downtimes, which in turn affect the overall productivity and quality of the final output. There is a need to analyze sensor readings and machine statuses to identify trends, uncover potential abnormalities, and provide actionable insights to enhance production performance.

**Key Performance Indicators (KPIs)**

**Total Machine ID:** The manufacturing machine had a count of **1000** ID. These machines were involved in the manufacturing of products. The product count “19” had the highest machine count ID involved which was **95**. It showed that **95** machines produced **19** product count.

**Total Product:** The sum of products produced by the manufacturing machine was 20,000 (**20K**).

**Total Sensor Reading:** The total sensor reading from the manufacturing machine was approximately 51.51 thousand (**51.51K**).

**Monthly Average Product Count:** The average amount of products produced monthly was **19.88**. It was calculated using the DAX function in Power Bi to get the monthly average product count.

**Total Machine Status:** Each machine status sums up distinctively. There are **323** On Machine Status, **345** Standby Machine Status, and **332** Off Machine Status.

**Insights**

* Product Quality Trends: The dashboard provides insight into the overall success rate of products passing quality checks which is **10353**. This help to monitor quality assurance across the manufacturing process. Anomalies or drops in pass rates which is **9522** can signal the need for adjustments in the production line or improved quality control processes.
* Abnormal Sensor Behavior: Through visualization, unusual spikes or drops in sensor readings were detected, which signified production abnormalities in certain products. In **2022**, there was a peak in sensor readings while in **2021** and **2023**, there was a drop in sensor readings. Addressing these issues early can prevent further production delays.
* Machine Status Impact on Production: By linking machine status (On, Off, Standby) with production output, the dashboard provides a clear view of how machine uptime affects product counts. High "Standby" times suggest inefficiencies in production delays. The Standby status of the machine was **345**, “On” machine status was **323** while “Off” machine status was **332**. **6916** products were obtained during “Standby” machine status while **6339** products during “On” machine status, and **6620** products during “Off” machine status.
* Sensor Performance and Quality Checks: The data revealed trends in sensor readings that was either True (pass) or False (fail) quality checks. The manufacturing machine had an average sensor reading of **53.49** with Quality Check “True” was higher than that of “False” with average sensor reading of **49.38**. Machines with consistently failing sensor readings may indicate malfunctioning equipment. The manufacturing machine had a high sensor readings which proved improve of product quality.

**Recommendations**

**Optimize Machine Utilization**: The analysis of machine statuses (On, Off, Standby) reveals periods of low utilization. Efforts should be made to reduce idle or standby times which was the highest status at **345** compared to the other two status, possibly by adjusting production schedules or optimizing machine maintenance routines.

**Enhance Quality Control:** Implement more stringent quality control measures for sensor data that frequently fails the quality check and indicates False. Automated systems could be used to alert operators immediately when readings fall outside acceptable ranges.

**Monitor Sensor Abnormalities:** It is recommended to closely monitor sensor readings that fail the quality check, as these could indicate potential abnormalities in the production process. Further investigation into these failures should be carried out by observing data from **2021** and **2023** to prevent future downtime and product defects.

**Conclusion**

The ability to visualize trends in sensor behaviour, monitor machine status, and assess quality check results allows for proactive maintenance and performance optimization. This data-driven approach will help the manufacturing company reduce machine downtime, improve machine utilization, and ensure consistent product quality. Leveraging these insights, the manufacturing company can drive great efficiency and reliability in manufacturing operations leading to high productivity.