STATISTICAL AND BUSINESS INSIGHTS

STATISTICAL ANALYSIS

- Total records : 2500
- Failure distribution:
    - Machine Failure instances: 1265
    - No_Machine_Failure instances : 1235

- **Summary Statistics of Numerical Fields:**

1. **Hydraulic_Pressure (bar):**
    a. **Minimum value:** -14.33
    b. **Maximum value:** 191.00
    c. **Average value:** 101.40
    d. **Standard deviation:** 30.22

2. **Coolant_Pressure (bar):**
    a. **Minimum value:** 0.33
    b. **Maximum value:** 11.35
    c. **Average value:** 4.94
    d. **Standard deviation:** 0.99

3. **Air_System_Pressure (bar):**
    a. **Minimum value:** 5.06
    b. **Maximum value:** 7.97
    c. **Average value:** 6.499
    d. **Standard deviation:** 0.406

4. **Coolant_Temperature(ºC):**
    a. **Minimum value:** 4.10
    b. **Maximum value:** 98.20
    c. **Average value:** 18.55
    d. **Standard deviation:** 8.532

5. **Hydraulic_Oil_Temperature:**
    a. **Minimum value:** 35.20
    b. **Maximum value:** 61.40
    c. **Average value:** 47.61
    d. **Standard deviation:** 3.755

6. **Spindle_Bearing_Temperature:**
    a. **Minimum value:** 22.60
    b. **Maximum value:** 49.50
    c. **Average value:** 35.06
    d. **Standard deviation:** 3.758

7. **Spindle_Vibration:**
    a. **Minimum value:** -0.46
    b. **Maximum value:** 2.00
    c. **Average value:** 1.00
    d. **Standard Deviation:** 0.342

8. **Tool_Vibration:**
    a. **Minimum value**: 2.16
    b. **Maximum value:** 45.73
    c. **Average value:** 25.41
    d. **Standard deviation:** 6.42

9. Spindle_Speed:

a. **Minimum value:** 0.00
b. **Maximum value:** 27957.00
c. **Average value:** 20274.79
d. **Standard deviation:** 3847.26

10. Voltage:

a. **Minimum value:** 202.00
b. **Maximum value:** 479.00
c. **Average value:** 348.99
d. **Standard deviation:** 45.31

11. Torque(Nm):

a. **Minimum value:** 0.00
b. **Maximum value:** 55.55
c. **Average value:** 25.23
d. **Standard deviation:** 6.111

12. Cutting:

a. **Minimum value:** 1.80
b. **Maximum value:** 3.93
c. **Average value:** 2.78
d. **Standard deviation:** 0.615

- Most Common Machine_ID: Makino_L1_Unit1_2013.
- Most Common Assembly_Line_No: Shopfloor-L1.

BUSINESS INSIGHTS

1. **Failure Rate Analysis:**
    - The failure rate of the fuel pump manufacturing process is approximately 51.68%. This indicates that just over half of the manufacturing instances result in machine failure.
    - Conversely, the success rate (no failure) is about 48.32%, suggesting that the manufacturing process can be improved to reduce machine failures and enhance production efficiency.
    - The high failure rates highlights a critical need for process optimization to improve the reliability and performance of the manufacturing system.

2. **Benchmark parameters:**
    - We can use the average operational parameters as benchmarks.
    - For example, if the hydraulic pressure exceeds 101.18 bar frequently in certain machines, it might be a red flag.

3. **Resource Allocation:**
    - The most common machine (Makino-L1-Unit-2013) and assembly line(Shopfloor-L1) indicate where most operations are focused.
    - Ensure these are well-maintained and possibly consider expanding capacity.