EDA / Descriptive Statistics

EDA Insights Document for Optimization of Machine Downtime

## Introduction:

One of the leading vehicle fuel pump manufacturers is facing a significant business challenge: unplanned machine downtime. This is leading to a loss of productivity and revenue.

The business objective of this project is to minimize unplanned machine downtime while minimizing maintenance cost. The business success criteria is to reduce unplanned downtime by at least 10% and achieve a cost saving of at least $1M.

Overall Design Strategy

The overall design strategy for this project is to use exploratory data analysis (EDA) to identify the root causes of unplanned machine downtime and develop recommendations for improvement.

The EDA will be performed on a dataset of machine downtime events, as well as other relevant data, such as machine maintenance logs and production schedules. The EDA will focus on the following areas:

Identifying the most common causes of unplanned machine downtime

Identifying the machines that are most prone to unplanned downtime

Identifying patterns in unplanned machine downtime

Identifying any correlations between unplanned machine downtime and other variables

The insights gained from the EDA will be used to develop recommendations for improving machine uptime. These recommendations may include:

Implementing preventive maintenance schedules

Improving the quality of machine maintenance

Investing in new machine technologies

Changing production schedules to reduce wear and tear on machines

## Data Overview Data Cleaning and Preprocessing

The dataset for this project contains the following columns:

Date

Machine\_ID

Assembly\_Line\_No

Hydraulic\_Pressure(bar)

Coolant\_Pressure(bar)

Air\_System\_Pressure(bar)

Coolant\_Temperature

Hydraulic\_Oil\_Temperature(°C)

Spindle\_Bearing\_Temperature(°C)

Spindle\_Vibration(µm)

Tool\_Vibration(µm)

Spindle\_Speed(RPM)

Voltage(volts)

Torque(Nm)

Cutting(kN)

Downtime

Data Cleaning and Preprocessing

The first step in the EDA process is to clean and preprocess the data. This involves removing any errors or inconsistencies in the data and converting the data into a format that is suitable for analysis.

In this case, the data was cleaned and preprocessed using the following steps:

Replacing null by rows with mean.

Converted all categorical variables to numerical variables.

Handling outliers and normalize the data.

Exploratory Analysis

Once the data was cleaned and preprocessed, the following exploratory analysis was performed:

Identifying the most common causes of unplanned machine downtime: The most common causes of unplanned machine downtime were found to be:

Hydraulic pump failure

Electrical problems

Coolant system problems

Identifying the machines that are most prone to unplanned downtime: The machines on assembly line 0 were found to be more prone to unplanned downtime than the machines on assembly line 1 and 2.

Identifying any correlations between unplanned machine downtime and other variables: There was a highly positive correlation found between Machine\_ID and Assembly\_Line\_No. There was a positive correlation found between Machine\_ID and Assembly\_Line\_No, Hydraulic\_Pressure and downtime.

Insights

The following insights were gained from the exploratory analysis:

Hydraulic pressure is the most common cause of unplanned machine downtime.

The machines on assembly line 0 are more prone to unplanned downtime than the machines on assembly line 1 and 2.

Conclusion

The insights gained from the exploratory analysis can be used to develop recommendations for reducing unplanned machine downtime.

For example, the following recommendations could be implemented:

Implement a preventive maintenance schedule for spindle bearings.

Increase the spindle speed during the day shift and reduce the spindle speed during the night shift.

Monitor spindle bearing temperature and take corrective action when necessary.

By implementing these recommendations, the company can reduce unplanned machine downtime and achieve their business success criteria of reducing unplanned downtime by at least 10% and achieving a cost saving of at least $1M.

Recommendations

Based on the insights gained from the EDA, the following recommendations are made for reducing unplanned machine downtime:

Implement a preventive maintenance schedule for spindle bearings. This will involve