**OPTIMIZATION OF MACHINE DOWNTIME**

**1.OVERVIEW**

* The primary business objective is to minimise unplanned machine downtime, aligning with the success criterion of achieving at least a 10% reduction in downtime.
* Conducted EDA using Python on datasets with 2500 rows and 16 columns, revealing insights into missing values, data types, and correlations through statistical methods.
* Visualizations were developed and present insights regarding unplanned machine downtime.

**2.OBJECTIVES**

* Minimize machine downtime.
* Maximize equipment efficiency.

**3.DATA PREPROCESSING**

* Dataset Inspection:

Displaying the description, info, and shape of a dataset.

* Handle missing values :

In given 2500 rows dataset there are only 143 null values so according to our data null values are lesser so we remove them .

* So after Pre-processing in dataset we have 2276 rows and 17 columns.

**4.EXPLORATORY DATA ANAYSIS**

* Calculating the first moment business decision (measures of central tendency such as mean, median, mode) for the dataset.
* Calculating the second moment business decision (measures of dispersion such as variance, standard deviation, range) for the dataset.
* Calculating the third moment business decision (skewness) for the dataset.
* Calculating the fourth moment business decision (kurtosis) for the dataset.
* Graphical Presentation (Histogram , Bar Plot ,Swarm Plot , Skew plot) using seaborn and matplotlib.

**5.STATISTICAL INSIGHTS**

* Data Cleaning slightly decreased the mean in some columns like Hydraulic Pressure (bar), Coolant Temperature (°C) etc. indicating that some high outliers were removed.
* There are some columns like Coolant pressure, Air system pressure, Torque etc. are Very stable output, suggesting reliable data without significant outliers. Consistent readings, indicating good data quality.
* There are 3 columns namely **Hydraulic Pressure, Torque and Cutting** are Highly correlated with Downtime. Here Hydraulic Pressure(-0.553) and Torque (-0.411) are very strongly Negative correlated with Downtime. Cutting (kN) (0.454) is very strongly Positive Correlated with Downtime.
* There is one parameter Spindle\_Speed(0.2730) which is Mediately correlated with downtime.

**6.BUSINESS INSIGHTS**

* Proportion of Downtime Occurrence for machine\_ downtime failure is 51.49% and for no machine\_downtime failure is 48.51%.
* Almost all data is for year 2022 (99.03%) and remaining for year 2021 (0.97%).
* If Hydraulic Pressure is approximately below 100 then there is chance of machine\_failure and Ensure optimal hydraulic pressure to reduce downtime.
* If Cutting Force is approximately between 1kN to 2.2kN than between 2.6kN to 3.3kN then there is lesser chance of machine\_failure Also Monitor and control cutting force to prevent increased downtime.
* If torque is approximately between 30Nm to 35Nm then there is minimal chance of machine\_failure and Maintain adequate torque levels to minimize downtime.
* If Hydraulic pressure above 75 and less than 175 and cutting force is 1kN to 2.2kN or 2.9kN to 3.4kN then there is chance of no machine\_failure.

**7.CONCLUSION**

In summary, the python based exploratory data analysis(EDA) of the Machine downtime has yielded important new information about the properties of the Machine Downtime. We investigated correlations between variables, identified outliers, and obtained a knowledge of distribution of important features using statistical summaries and visualizations. The quantative and qualitative features of the datasets were analyzed in detail through the use of various plots, including pair,box,Swarn plot, Skewness Plot, Kurtosis Plot and Pair Plot. Finding patterns, trends and possible topics for more research was made easier by this EDA method. Furthermore, the analysis demonstrated the ability to visualise and analysize complicated datasets using Python tools such as Matplotlib, Sea-born and Pandas. The results provide a thorough grasp ofthe Machine Downtime datasets and lay the groundwork for more in-depth studies and modeling.