**The PEXITICS : Preventive Maintenance Project Approach Note**

**Problem Statement\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

To perform data analysis on data about machine breakdowns and build predictive Model in order to assist Preventive Maintenance Program by predicting breakdown, reducing downtime, predicting remaining useful life, increasing life expectancy, determining factors driving breakdown etc.

**Data\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Data provided have 90,000 instances of the Maintenance work done across different machines in one year that work on 3 pressure points principle which captures breakdown instances from the installation of those machines. It also provides information which factories are using those machines (team) and companies that manufactured those machines (provider).

**Approach\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Primary points to investigate***

* Is there any relationship between lifetime and machine break down? we will perform analysis to determine the relationship between *lifetime ( Explanatory Variable*) of *machine and breakdown(Response Variable)* event to **determine and prevent downtime**, **designing schedule for preventive maintenance**, **predicting and improving life expectancy, to** **investigate period of Machine deterioration ,predict remaining useful life.**
* Is there any relationship between the pressure at different points and machine break down? We will perform analysis to determine how *pressure ( Explanatory variable) at different points drives rate of breakdown(Response variable)* in order to give insight about maintaining pressure at different pressure points an**d determine risk window for pressure** , **yield point** at 3 pressure points, forming **guidelines for preventive maintenance.**
* Are Breakdown events consistent across (Team) Factories using machine, (Providers) Manufacturers, Pressurepoints, lifetime? Any **Deviation (inconsistency) from the population on checking interaction between these variable with exploratory analysis can** **be separated for the further investigation by doing Segmentation.**
* **Reliability-centered maintenance** to answer reason of failure, downtime, the effect of failure, prevention of failure.

**Analysis\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* Cleaning data, creating derived variables, Data Preparation, removal of outliers.
* **Exploratory Analysis** **and Descriptive analysis** using graphs, ggplot2 etc. and reporting insights. We will retrieve information, such as the relation of every variable with the lifetime of the machines, applying some data exploratory tools like cross tables, pivots. We will also use interactive box plots where the user could identify the value of every element in the graphic.
* **Segmentation** of data according to breakdown behavior in different groups.
* **Survival Analysis technique** with “*Kaplan Meier survival analysis” and “Cox Proportional Hazard model”* to predict **Life expectancy** and **the probability of failure** with respect to changes in pressure and lifetime, **Remaining useful life ( how much machine will survive from now)**
* **Analysis of lifetime through** a Kaplan-Meier(Survival Analysis) plot showing the influence of every variable independently and as a whole
* **Random forest** or decision tree model to **derive rules** across different pressure levels and lifetime within each segment.
* **Reporting insights** from analysis to form guidelines for preventive Maintenance with good visualization using graphs, charts , cross tables, diagrams etc in easy to understand and business-friendly manner
* **Tools :-** R, advanced excel