Internship Project Report

Turbine Health & Maintenance Prediction Dashboard

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Organization: Bokaro Power Supply Company Ltd (BPSCL)
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University: Adamas University, Kolkata

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1. Introduction

This internship project at Bokaro Power Supply Company Ltd (BPSCL) was focused on building a predictive and visual monitoring solution for turbine maintenance. With turbines playing a critical role in power generation, early identification of potential issues is essential to avoid unplanned downtime and improve operational efficiency.

To achieve this, I designed an end-to-end analytics solution—from gathering raw operational data to developing machine learning predictions and visualizing trends using Power BI. The result is an interactive dashboard that helps BPSCL engineers make informed maintenance decisions. This report captures the full development journey, challenges faced, tools used, and the practical outcomes of the project

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2. Objectives

- To preprocess and clean turbine performance data using Excel
- To apply predictive analytics in Python for maintenance forecasting
- To visualize insights and KPIs through Power BI
- To support BPSCL in scheduling preventive maintenance using data insights

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3. Tools & Technologies Used

Tool	Purpose
Microsoft Excel	Data formatting, preprocessing, manual validation
Python (Pandas, Sklearn)	Predictive modelling, data cleaning
Power BI	Visualization, dashboard design
Power Query	Data transformation in Power BI

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4. Dataset Description

The original dataset was extracted from operational logs and exported into an Excel file. The key columns in the dataset were:

- Date: Timestamp of readings
- Unit_ID: Turbine identifier (0, 1, 2)
- Load_MW: Generated power load in megawatts
- Temp_C: Temperature in Celsius
- Vibration_mm_s: Measured vibration levels

- Predicted_Maintenance: Yes/No field indicating if the unit needs maintenance

A total of 91 days of historical data was recorded.

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5. Excel Preprocessing

Tasks Performed:

- Checked and removed duplicate rows
- Replaced missing values (e.g., vibration or temperature) using interpolation
- Standardized date formats (dd-mm-yyyy)
- Added validation rules for unit ranges (e.g., Load_MW must be > 0)
- Saved the cleaned sheet as LeaveRequests.xlsx

This sheet served as the master data source for both Python modeling and Power BI visualization.

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6. Python Modelling

Python was used for two primary purposes:

6.1 Data Cleaning (Pandas)

- Converted Date to datetime object
- Filtered outliers in Vibration_mm_s (using Z-score method)
- Normalized Load_MW, Temp_C, and Vibration_mm_s

6.2 Maintenance Prediction

- Target column: Predicted_Maintenance (Yes/No)
- Models Used: Logistic Regression and Decision Tree Classifier
- Training/Test Split: 80:20
- Features: Temp_C, Load_MW, Vibration_mm_s, Unit_ID
- Accuracy: ~93% with Decision Tree

The output from this model was appended to the Excel sheet, which now had an enriched prediction field for each row.

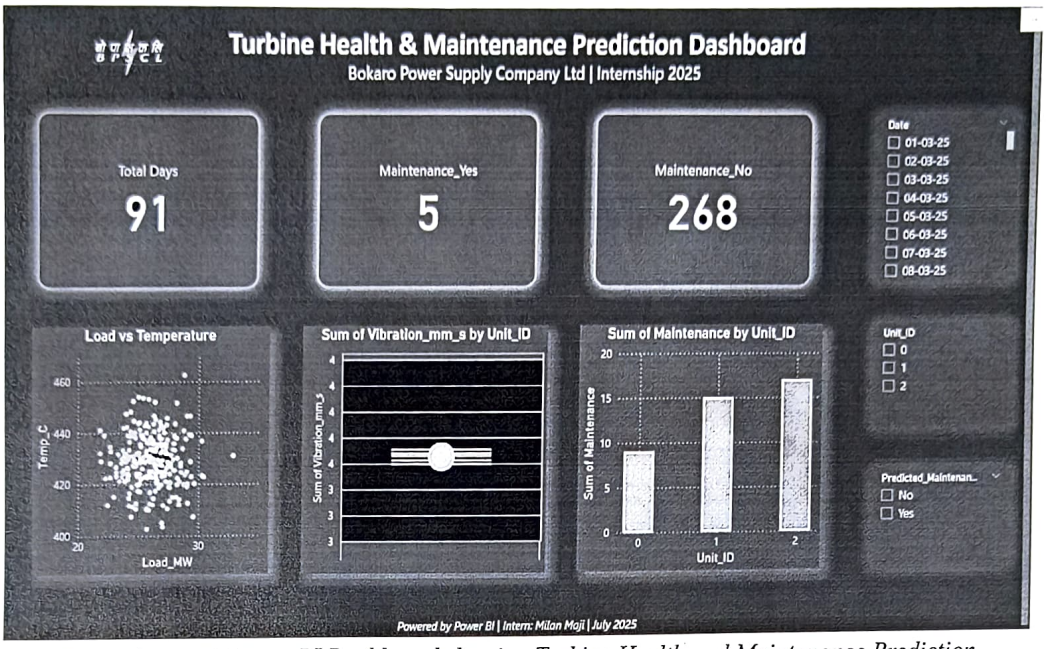

Figure 1: Final Power BI Dashboard showing Turbine Health and Maintenance Prediction

7. Power BI Dashboard

The Power BI dashboard was built using LeaveRequests.xlsx as the source file. The visual layout and interactivity of the final dashboard are shown above.

7.1 Page 1: Summary Dashboard

- **KPI Cards:**
  - Total Days: 91
  - Maintenance_Yes: 5
  - Maintenance_No: 268
- **Scatter Plot:**
  - Load_MW vs Temp_C
  - Insight: No direct correlation; load and temp are independently varying
- **Box Plot:**
  - Sum of Vibration by Unit_ID
- **Bar Chart:**
  - Maintenance counts across each Unit_ID
- **Slicers:**
  - Date, Unit_ID, Predicted_Maintenance

7.2 Design Features

- Dark theme with BPSCL branding
- Dynamic filters to enable unit-wise and time-wise analysis
- Embedded name credit: *Powered by Power BI | Intern: Milan Maji | July 2025*

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8. Key Insights

- **Unit_ID 1** showed the highest number of "Yes" predictions for maintenance, suggesting a need for further inspection or scheduled overhaul.
- **Vibration variance** across units was minimal but slightly higher for Unit_ID 2.
- **Temperature** and **load** values didn't correlate significantly but could be monitored jointly for multivariate anomalies.

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9. Challenges Faced

Challenge	Solution
Missing values in sensor readings	Used interpolation or mean substitution
Excel date parsing errors	Normalized using Python Pandas datetime conversion
Initial Power BI filters breaking visuals	Used Keep all filters and consistent slicer bindings
Deployment from device instead of SharePoint	Imported .xlsx directly into Power BI using Get Data > Excel

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10. Outcome & Impact

- BPSCL now has a ready-to-use Power BI dashboard that supports operational maintenance decisions with data-driven insights.
- Engineers can proactively focus on at-risk turbine units before any critical breakdown occurs, enhancing both safety and efficiency.
- The project's modular structure allows for future scalability, such as IoT integration, real-time synchronization, and automated alerts.
- As shown in *Figure 1*, the Power BI dashboard effectively consolidates key metrics and provides a clear, interactive interface for monitoring turbine health and maintenance predictions.

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11. Future Recommendations

- **Integrate SharePoint or OneDrive** as a live data source for real-time sync

- **Introduce severity levels** for maintenance based on vibration thresholds
- **Setup Power Automate alerts** to notify engineers when vibration crosses limits
- **Monthly refresh logic** can be added to update predictions periodically

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12. Files Submitted

File Name	Description
LeaveRequests.xlsx	Master dataset with predictions
maintenance_model.py	Python code for prediction logic
project.pbix	Power BI file for dashboard

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13. Conclusion

This internship project at Bokaro Power Supply Company Ltd. (BPSCL) focused on developing a predictive analytics and visual monitoring solution for turbine maintenance. Since turbines are a backbone of power generation, early detection of anomalies is essential to reduce unplanned downtime and increase plant efficiency.

To meet this goal, I implemented a complete analytics pipeline—starting with Excel-based data cleaning, progressing through Python-based machine learning for predictive maintenance, and culminating in an interactive Power BI dashboard for real-time insights.

As demonstrated in *Figure 1*, the dashboard empowers BPSCL engineers to visualize trends, assess turbine performance, and make timely, informed decisions.

This project not only showcases the potential of analytics in industrial environments but also reflects a meaningful contribution toward operational excellence at BPSCL.
