# OEE Dashboard for Eastern Bearings Pvt. Ltd

**Minor Project-II**

**(ENSI252)**

*Submitted in partial fulfilment of the requirement of the degree of*

**B.Tech CSE (DATA SCIENCE)**

*to*

# K.R Mangalam University

*by*


**Akshat Sharma (2301420027)**
**Prateek Kumar Prasad (2301420018)**
**Yatharth Chopra (2301420022)**
**Rajdeep Sutradhar (2301420001)**

Under the supervision of

**Amit Sir**
**Associate Professor**
**K.R Mangalam University**

**Anuj Sir**
**QMS Head**
**Eastern Bearing Pvt. Ltd.**

Department of Computer Science and Engineering

School of Engineering and Technology

K.R Mangalam University, Gurugram- 122001, India


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## CERTIFICATE

This is to certify that the Project Synopsis entitled, **OEE Dashboard for Eastern Bearings Pvt. Ltd** submitted by **Akshat Sharma(2301420027) , Prateek Kumar Prasad(2301420018), Yatharth Chopra(2301420022) and Rajdeep Sutradhar(2301420001)** to **K.R Mangalam University, Gurugram, India,** is a record of bonafide project work carried out by them under my supervision and guidance and is worthy of consideration for the partial fulfilment of the degree of **Bachelor of Technology** in **Computer Science and Engineering** of the University.

**Type of Project (Tick One Option)**

✓
**Industry/Research/University Problem**

Amit Ku

(Signature of Internal supervisor)
(Name and designation of supervisor)

(Signature of Project Coordinator )

Date: 1/5/25

# INDEX

# ABSTRACT

In today's dynamic manufacturing environment, operational excellence is vital for maintaining competitiveness and sustainability. **Eastern Bearings Pvt. Ltd. (EBPL)**, a prominent manufacturer in the bearing industry, faced persistent challenges in tracking and improving machine performance due to unstructured data, manual reporting processes, and a lack of real-time insights. To resolve these issues, our team from **K.R. Mangalam University** initiated an industry-academic collaboration to develop an **Overall Equipment Effectiveness (OEE) Dashboard**, focused on streamlining the performance monitoring of grinding department machines.

The project began in January 2025 with multiple rounds of meetings and feedback from EBPL. A six-month dataset (August 2024 to January 2025) from EBPL's MSD (Manufacturing System Data) was collected, which included inconsistencies such as negative values, missing fields, and varied time formats. These issues were resolved through rigorous data cleaning and structuring using Excel and Power Query. We first developed a prototype dashboard in Excel to validate key metrics and then transitioned to a scalable Power BI solution for real-time visualization and advanced filtering.

The final dashboard, integrated with Streamlit for enhanced user accessibility, includes features such as machine-wise filtering, shift-wise analysis, pie and bar chart visualizations, and KPIs such as OEE, Availability, Performance and Quality. Real-time access to visual insights has empowered EBPL's management and plant operators to make data-driven decisions and improve productivity. This project not only bridges the gap between theoretical learning and industrial application but also demonstrates how structured analytics and business intelligence tools can transform traditional manufacturing practices.

**Keywords**

*OEE, Power BI, Streamlit, Manufacturing Analytics, Data Visualization, Industrial Dashboard, Automation, KPI Tracking, Data Cleaning, EBPL, MSD System*

# Chapter 1

# Introduction

Manufacturing companies today operate in an increasingly complex and competitive environment. Achieving maximum efficiency, minimizing downtime, and maintaining high-quality production are essential goals for businesses in the industry. **Overall Equipment Effectiveness (OEE)** is a widely recognized metric used to assess how well manufacturing equipment is performing. It provides a detailed analysis by evaluating three key aspects: **Availability, Performance, and Quality**. By calculating OEE, organizations can identify production losses, uncover inefficiencies, and take targeted actions to optimize operations, ultimately leading to improved profitability.

At **Eastern Bearings Pvt. Ltd. (EBPL)**, a leading manufacturer in the bearings industry, there is a clear recognition that operational efficiency plays a crucial role in maintaining a competitive edge. However, despite the availability of advanced machinery and a skilled workforce, the company faces significant challenges in monitoring and improving production performance. The current lack of real-time insights, combined with manual data entry errors and inconsistent data collection methods, has led to inefficiencies that hinder decision-making and limit the potential for improvement.

This project aims to address these issues by developing a **real-time OEE dashboard** that integrates data from various machines and processes on the shop floor. By automating data collection and presenting it in a centralized, easy-to-understand format, the dashboard will enable EBPL's management to monitor equipment performance in real-time, identify bottlenecks quickly, and make data-driven decisions that improve productivity and efficiency across the plant. The ultimate goal is to create a streamlined, transparent, and scalable system that supports continuous improvement and operational excellence.

# Chapter-2

## Background of the Project

Eastern Bearings Pvt. Ltd. (EBPL), like many manufacturing companies, operates in a competitive market where the need for high-quality products, timely delivery, and cost efficiency is critical. The company produces bearings for a wide range of industries, and efficient manufacturing is essential for maintaining customer satisfaction and profitability. Despite having modern machinery and skilled workers, EBPL has faced several challenges that have prevented them from fully optimizing their production lines.

One of the key challenges at EBPL is the lack of a systematic approach to data collection. Machine performance data is manually recorded on paper or in Excel sheets, leading to frequent errors and inconsistencies. With no standardized method of recording, the information is fragmented and difficult to interpret. This makes it hard for managers to get a real-time picture of equipment performance or identify underlying issues that cause inefficiencies.

The absence of real-time visibility into production data also means that decision-making is often delayed. Problems such as unplanned downtime, underperformance, or quality defects are discovered too late, causing further delays and increased costs. Furthermore, without detailed insights into performance metrics, EBPL's team struggles to pinpoint root causes of inefficiencies, making it difficult to implement corrective measures promptly.

In response to these challenges, the company decided to embark on a project to develop a solution that would bridge the gap between raw data and actionable insights. The proposed solution is the development of an OEE dashboard that will collect and visualize real-time data from machines, track key performance indicators (KPIs), and allow plant managers to take immediate, data-driven action. The goal of the project is to reduce downtime, improve performance, and enhance product quality by providing clear, real-time insights into how effectively each machine is performing. This dashboard will not only automate the data collection process but also help create a culture of continuous improvement by allowing EBPL to identify bottlenecks and inefficiencies faster and more accurately.

This project aligns with EBPL's broader strategy of digital transformation and data-driven decision-making. By leveraging technology to streamline data management and enhance operational visibility, the company aims to foster a more efficient, responsive, and competitive manufacturing environment. The OEE dashboard will serve as a crucial tool in achieving these goals and driving the company toward a future of smarter manufacturing.

# Chapter 3

## Motivation

The motivation behind this project is rooted in both real-world industrial relevance and the learning potential it offers to our team. In today’s data-driven manufacturing environment, companies must continuously seek ways to improve efficiency, reduce downtime, and make informed operational decisions. However, many small- to mid-sized enterprises—like Eastern Bearings Pvt. Ltd. (EBPL)—struggle to harness the power of data due to a lack of standardized systems and limited access to real-time insights. This presents a compelling opportunity to create tangible impact by developing a practical, scalable solution tailored to real industry needs.

From an academic and professional standpoint, this project provides an exceptional learning experience for our team. It allows us to engage with real production data, understand how manufacturing workflows operate in practice, and explore the challenges associated with capturing, processing, and visualizing that data. The project has enabled us to apply our technical skills in areas such as data cleaning, data visualization, and dashboard development, while also gaining hands-on experience in industrial process analysis and performance metrics like OEE.

Additionally, the collaboration with EBPL adds a socially meaningful dimension to our work. By contributing to a local company's digital transformation journey, we are helping them move toward more efficient and transparent operations. The development of the OEE dashboard is not only a technical exercise but also a strategic initiative that has the potential to improve decision-making, reduce losses, and promote a culture of continuous improvement within the organization.

This project serves as a bridge between academic knowledge and real-world impact, empowering us to turn theoretical concepts into practical tools that address actual business challenges. It is this blend of technical learning, real-world relevance, and meaningful contribution that truly motivates our team to deliver a successful and impactful solution.

# Chapter 4

## Literature Review / Comparative Work

As the manufacturing industry continues to evolve, data-driven decision-making has become essential for maintaining efficiency, reducing downtime, and maximizing productivity. To support this, a variety of off-the-shelf OEE dashboards have emerged, typically embedded within platforms like Microsoft Power BI, Tableau, Siemens Opcenter, and SAP OEE Management. These tools offer robust features such as interactive visualizations, automated data processing, and advanced analytics.

However, many of these tools are costly, require technical expertise, and are often generic, making them difficult to align with the specific needs of smaller manufacturers like Eastern Bearings Pvt. Ltd. (EBPL). They may also require substantial time for integration and customization, making them less suitable for organizations with limited IT resources or manual data systems.

In contrast, our project delivers a custom-built, lightweight, and highly tailored OEE dashboard solution for EBPL. This dashboard is:

- Designed to seamlessly integrate with existing Excel-based workflows,
- Offers real-time visualization of key performance metrics,
- Requires minimal technical know-how for use and updates,
- And most importantly, it can be hosted on the cloud or a local server, making it accessible from any location and on any device with internet access.

This remote accessibility ensures that plant managers, decision-makers, and team leaders can monitor production performance anytime, anywhere—improving operational responsiveness and transparency.

Our solution **bridges the gap** between traditional reporting and enterprise-grade BI tools by offering a **cost-effective, real-time, and remotely accessible dashboard** tailored to EBPL's needs—enabling **data-driven decisions from anywhere**

**Comparison Table :-**

| Feature / Criteria | Manual Reporting | Excel Dashboard | Power BI Integration |
|---|---|---|---|
| Data Entry Method | Handwritten or typed | Manual input via Excel sheets | Can be automated or linked to sources |
| Error Rate | High (human error-prone) | Moderate | Low (if integrated properly) |
| Real-time Updates | Not available | Limited (manual refresh) | Available (with proper setup) |
| Visualization Quality | None | Basic charts & graphs | Advanced, interactive dashboards |
| Customization | Very limited | Medium | High, but requires expertise |
| Scalability | Poor | Moderate | High |
| Setup & Maintenance | Simple but inefficient | Moderate effort | High initial effort & cost |
| Remote Accessibility | Not possible | Limited (local file access) | Yes (via web or cloud) |
| Cost | Minimal | Low | Medium to High |
| Decision Support | Delayed | Faster than manual | Fast and data-driven |
| Best Fit For | Very small operations | Small to medium teams | Medium to large-scale operations |

# Chapter 5

# Gap Analysis

A thorough analysis of EBPL's current data reporting and production monitoring practices revealed several critical gaps that hinder the effectiveness of their performance measurement and decision-making processes. These issues were discussed during the 12 April presentation and documented in the MOM. Identifying these pain points was essential in designing a targeted, impactful solution.

**Identified Problems at EBPL**

1. Negative Values in Data
   - In certain records, especially in performance-related fields, negative values were found, indicating potential errors in either data entry or formula calculation.
2. Shift Complexity
   - EBPL follows a multi-shift system with custom shift times, breaks, and overlapping transitions. The complexity was not being handled well in standard reporting, leading to incorrect time allocation for production and downtime.
3. Inconsistent Time Format
   - Time entries across different Excel reports followed inconsistent formats (e.g., HH:MM:SS, decimal hours, or text). This inconsistency caused formula errors and confusion in OEE calculations.
4. Mismatch Between MSD (Manufacturing System Data) and Excel Reports
   - There were observable discrepancies between machine-generated data and manually maintained Excel sheets, leading to mistrust in reported metrics and misalignment in decisions based on those reports.
5. Manual Data Entry and Errors
   - Heavy reliance on manual input increased the risk of human error and significantly slowed down the reporting process.
6. Lack of Real-Time Monitoring
   - EBPL lacked real-time production tracking or automated updates, causing delayed decisions and reactive rather than proactive management.

**How Our Solution Addressed These Gaps**

| Problem Identified | How Our Dashboard Solution Addresses It |
|---|---|
| **Negative Values** | Implemented data validation checks and flagging rules to highlight any unexpected negative inputs for review and correction. |
| **Shift Complexity** | Developed a custom shift-mapping logic in the dashboard backend to handle EBPL's unique schedule (A, B, G shifts), ensuring accurate calculations. |
| **Time Format Inconsistency** | Standardized all input sources to a uniform HH:MM:SS format, with backend conversion logic to maintain consistency across calculations. |
| **MSD vs Excel Mismatch** | Created automated reconciliation rules to identify and highlight mismatches, along with a framework to standardize machine and manual data formats. |
| **Manual Entry Errors** | Introduced a predefined Excel template with dropdowns, protected fields, and logic-based validation to minimize human errors. |
| **No Real-Time Insights** | Integrated the dashboard with auto-refresh logic (via Power BI or scripts) to provide near-real-time data visualization for shop-floor and leadership teams. |

**Major Observations During Analysis**

- Operator dependency: Data accuracy depended heavily on the operator's attention and manual discipline.
- No centralized system: Data resided in multiple unlinked files, increasing retrieval time and decreasing accountability.
- Delayed feedback loop: EBPL managers were receiving performance insights after 24–48 hours, reducing agility in responding to downtime or quality issues.
- Undefined performance targets: There was no visual tracking of expected vs. actual KPIs (like Availability, Performance, Quality) on a daily or weekly basis.

**Impact of Gap Resolution**

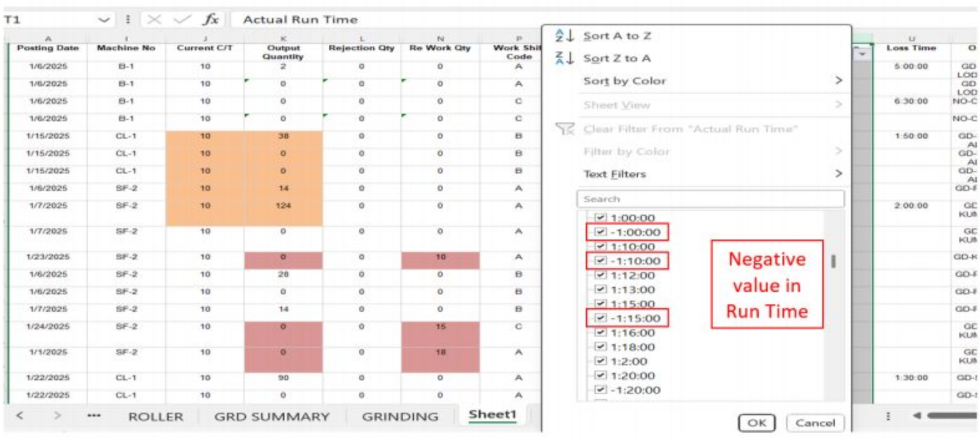
By addressing these gaps, our dashboard not only improves data accuracy and timeliness, but also empowers EBPL to make data-driven decisions faster. The solution promotes transparency, supports continuous improvement, and sets a strong foundation for future automation.

## 03 6 Month MSD-ERP Data Analysis

| OBSERVATION | | |
|---|---|---|
| Sl. No. | MSD-ERP Data | Observation |
| 01 | Negative Values in Run Time & Down time | We have noticed that some entries contain negative values, which is not feasible as time cannot be negative. |
| 02 | Work Shift Complexity | The presence of A, B, C shifts along with day and night shifts makes it challenging to structure and plot data effectively.. |
| 03 | Time Format Discrepancies | • Cycle time is recorded in seconds, while planned time and downtime are in hours.<br>• For consistency, all time values should be converted to seconds to maintain uniformity in calculations. |
| 04 | OEE Sheet vs MSD System Mismatch | The OEE data in the provided sheet does not match the values in your MSD system, leading to discrepancies in the final reports |

## 04 Negative Values in Run Time

1) **Negative Values in Run Time & Down time**: We have noticed that some entries contain negative values, which is not feasible as time cannot be negative.



## 08 Time Format Discrepancies

4) OEE Sheet vs MSD System Mismatch: The OEE data in the provided sheet does not match the values in your MSD system, leading to discrepancies in the final reports.

F6 3600

**MACHINE NO :B2**

| Date | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| Shift | A | B | A | B | A | B | A | B |
| BRG. NO. | 24122CA | 24122CA | 24122CA | 24122CA | 24122CA | 24122CA | 24122CA | 315189MB |
| Total Planned Time | 28800 | 28800 | 43200 | 43200 | 43200 | 43200 | 43200 | 43200 |
| Total Down Time | 0 | 100 | 11400 | 6000 | 3600 | 0 | 18000 | 7200 |
| Availability | 1.00 | 1.00 | 0.74 | 0.86 | 0.92 | 1.00 | 0.58 | 0.83 |
| Cycle Time | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 |
| Number of Pass | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| Calculated Cycle Time | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 720 |
| Target Productio | 120 | 120 | 133 | 155 | 165 | 180 | 105 | 50 |

B-2 B-3 B-4 B-5 B-6 B-7 PL-1 CR-4 CR-5 TR-1 TR-2

**(A)**
Planned Time is 43200 sec on 3/1/25 in both shift (A,B)

**(B)**
Down Time is 3600 sec for shift A and 0 sec for Shift B on 3/1/25

# Chapter 6

## Problem Statement

Eastern Bearings Pvt. Ltd. (EBPL), a mid-scale industrial manufacturer, has long faced challenges in assessing its production line efficiency due to the absence of a structured and automated monitoring system. The company relies primarily on manual data entry, individual Excel spreadsheets, and operator-recorded reports to monitor machine performance and daily output. These practices not only consume valuable time but also introduce a high margin of human error and inconsistency.

One of the most critical gaps identified was the inability to calculate or monitor Overall Equipment Effectiveness (OEE) accurately—a global standard metric used to gauge how effectively manufacturing equipment is being utilized. Without a unified system, departments were working in silos, and reports often presented conflicting or delayed data. Key decision-makers lacked access to real-time, actionable insights, relying instead on lagged manual summaries that were prone to inaccuracies.

Several specific challenges were observed:

- Time Format Inconsistencies: Operators used varying time formats, making it difficult to standardize and calculate uptime, downtime, or cycle time across reports.
- Data Redundancy & Mismatches: Discrepancies between machine data (MSD) and Excel-based reports were common, leading to mistrust in the reliability of performance figures.
- Negative and Missing Values: Data validation was absent, resulting in negative or incomplete entries that skewed OEE metrics.
- Shift Complexity: EBPL operates on a multi-shift schedule with overlapping timeframes. The lack of proper shift-mapping logic caused confusion in output distribution and performance tracking.
- Manual Compilation & Delayed Reports: At the end of each shift, reports had to be compiled manually from multiple files, delaying critical decisions and slowing responsiveness to machine failures or production drops.

  These inefficiencies contributed to poor visibility into machine health, underutilized capacity, and a reactive rather than proactive operational approach.

To bridge this gap, the need for a centralized, interactive, and intelligent dashboard became evident—one that could:

- Automate data intake and validation from structured Excel inputs or live machine data,
- Standardize calculations for Availability, Performance, and Quality, providing a reliable OEE metric,
- Enable real-time monitoring of shop-floor activities with shift-wise and machine-wise granularity,
- And ultimately, support EBPL's vision of continuous improvement and data-driven decision-making.

This project was initiated to fulfil that vision—by building a customized OEE Dashboard, tailored specifically to EBPL's processes, that transforms scattered data into a powerful decision-support system.

# Chapter 7

## Objectives

The primary objective of this project is to design and deploy a centralized OEE dashboard tailored to the operational needs of Eastern Bearings Pvt. Ltd. (EBPL). The dashboard aims to transform raw production data into actionable insights that support real-time decision-making and continuous improvement on the shop floor. Specific objectives include:

- Collect and analyze six months of production data from the Machine Status Data (MSD) logs and operator-maintained Excel reports to identify patterns, errors, and trends.
- Clean, validate, and preprocess the raw data, addressing issues such as inconsistent time formats, negative values, missing entries, and shift misalignments to ensure accurate metric calculation.
- Calculate and visualize key manufacturing KPIs, including:
  - Overall Equipment Effectiveness (OEE)
  - Mean Time Between Failures (MTBF)
  - Mean Time To Repair (MTTR)
  - Downtime reasons and frequency
  - Production counts by shift and machine
- Develop interactive dashboards using Power BI for data visualization and integrate with a Streamlit web app for enhanced accessibility, especially for management and supervisors with non-technical backgrounds.
- Deliver role-specific, actionable dashboards that:
  - Help shop floor operators monitor shift-wise machine performance
  - Enable the maintenance team to track downtime and root causes
  - Assist management in identifying bottlenecks and making data-driven operational decisions
- Ensure cross-platform accessibility, allowing dashboards to be accessed from desktops, tablets, or mobile devices — anytime, anywhere.

# Chapter 8

# Tools and Software Used

To address the inefficiencies in production data monitoring at Eastern Bearings Pvt. Ltd. (EBPL), our team adopted a set of tools that aligned with the project's evolving technical requirements, user constraints, and scalability goals. These tools were selected not only for their functionality but also for their accessibility to both technical and non-technical users at the company. Each tool played a unique role at a different stage of the project, from data collection to deployment.

Initially, **Microsoft Excel** served as the backbone for prototyping. Since EBPL's team was already comfortable with Excel, it made sense to use it for collecting raw data in a structured manner. We created standardized Excel templates with dropdowns, color coding, and field validations to reduce operator error and enforce data consistency across shifts.

To prepare this data for dashboarding, **Power Query** (an Excel and Power BI tool) was used for preprocessing. It helped transform messy raw data—such as inconsistent time formats, negative values, and mismatched shift entries—into structured, clean datasets. Power Query's automation capabilities were essential in creating repeatable data cleaning processes, allowing us to focus more on analysis than on manual corrections.

**Power BI** was the primary tool for visualization. It was chosen for its powerful dashboarding capabilities, built-in support for KPIs, and its ability to filter, drill down, and compare data across machines and shifts. It also allowed us to publish reports to the cloud, making dashboards accessible in real time across devices.

To make the solution more accessible and customized to EBPL's workflow, we integrated the Power BI reports into a **Streamlit web application**. Streamlit provided a lightweight and interactive frontend, allowing management to access the dashboard via a simple web URL, with customized controls for navigation and filtering beyond what Power BI natively offered.

Looking ahead, we plan to integrate **Python** for automation and advanced analytics. Python will enable automated data extraction, cleaning with libraries like Pandas, and even forecasting equipment breakdowns using predictive models. We also plan to use **SQL** for building a centralized data pipeline where future data from machines can be stored in a structured format, enabling real-time querying and integration with dashboards.

**Tools & Why They Were Used :-**

- **Excel**
  - Used for initial data entry by operators and early-stage prototyping
  - Familiar interface for EBPL team; easy to standardize and validate inputs
  - Simulated OEE calculations before moving to Power BI
- **Power Query**
  - Used for transforming raw data (cleaning nulls, fixing time formats, shift segmentation)
  - Automated the data preparation step and ensured data consistency
  - Integrated well with both Excel and Power BI
- **Power BI**
  - Main tool for creating the OEE Dashboard
  - Enabled interactive visualizations and cross-filtering (by machine, shift, downtime reason)
  - Offered cloud hosting and scheduled refresh features
  - Provided role-based dashboard access
- **Streamlit**
  - Used to host the dashboard within a custom web application
  - Offered simple UI with Python backend for more flexibility than native Power BI embedding
  - Made the solution mobile/tablet accessible with a clean user interface
- **Python (Planned)**
  - Will automate data ingestion and preprocessing
  - Enables custom logic for anomaly detection, forecasting, and reporting
  - Supports future integration with APIs or sensor-driven machine data
- **SQL (Planned)**
  - Will serve as the backend database for real-time machine data
  - Supports structured queries and historical data storage
  - Enables faster integration with Python and Power BI for automated updates

# Chapter 9

# Methodology

The methodology for developing the OEE Dashboard for Eastern Bearings Pvt. Ltd. (EBPL) was a systematic, iterative process that focused on clean data collection, effective preprocessing, interactive dashboard development, and real-time deployment. The approach involved multiple stages, each contributing to the evolution of the solution and refining the product based on stakeholder feedback.

## Architecture

The architecture of the OEE Dashboard is built on a data pipeline that progresses through multiple stages to ensure accurate data collection, preprocessing, and real-time insights. The flow of data follows the sequence:

1. Data Collection: The data is initially collected from Machine Status Data (MSD) logs and Excel reports maintained by the operators. This includes machine performance data such as Machine ID, Shift, Planned Time, Run Time, Downtime, and other machine-specific variables.
2. Preprocessing: The raw data undergoes cleaning and transformation using Power Query within Excel and Power BI. This step addresses issues like negative values, missing data, time discrepancies, and ensures that all data is in a consistent format suitable for further analysis.
3. Power BI: Once the data is clean, it is imported into Power BI, where it is used to generate interactive dashboards. Power BI processes the data, calculates key metrics such as OEE, MTBF, MTTR, and generates visual insights. The dashboards allow for drill-downs by machine, shift, downtime reason, and other variables.
4. Streamlit: The Power BI dashboards are embedded into a Streamlit web app, providing users with a simple and responsive interface. This allows shop floor employees and management to access real-time, actionable insights on any device with an internet connection.

**Data Description**

The data used for this project spans 6 months of production activity, collected from the Machine Status Data (MSD) logs maintained at EBPL. The dataset contains the following key variables:

- Machine ID: A unique identifier for each machine on the shop floor.
- Shift: The shift during which the machine data was recorded, typically categorized as Shift 1, Shift 2, or Shift 3.
- Planned Time: The total time allocated for the machine to operate in a given shift, often determined by the production schedule.
- Run Time: The actual time the machine was operating and producing parts, measured in minutes or hours.
- Downtime: The total time when the machine was not operating, which could be caused by failures, maintenance, or other disruptions.
- Cycle Time: Time taken for the machine to complete one full cycle of production.
- Downtime Reasons: Categorized reasons for downtime (e.g., machine breakdown, maintenance, or material shortages).

  These variables are key to calculating Overall Equipment Effectiveness (OEE), which is based on three primary components: Availability, Performance, and Quality.

**Exploratory Data Analysis (EDA)**

Before processing the data, an Exploratory Data Analysis (EDA) was conducted to identify issues that would impact the accuracy of our metrics. Some common anomalies found in the dataset included:

- Negative Values: Several instances of negative Run Time and Downtime values, which are unrealistic and indicate data entry errors or miscalculations.
- Time Discrepancies: Inconsistent time formats (e.g., hours, minutes, seconds in different formats) were found across different shift logs, leading to difficulties in aggregating the data correctly.
- Null Values: Missing entries for important variables like Planned Time, Run Time, or Downtime made it necessary to decide whether to impute values or exclude those rows.

- Shift Complexity: Data from shifts with overlapping times or incorrect shift assignments were flagged and needed correction.

  These issues were resolved using Power Query for data cleaning, which allowed for the standardization of time formats, removal or correction of negative values, and imputation or exclusion of missing data

**Procedure**

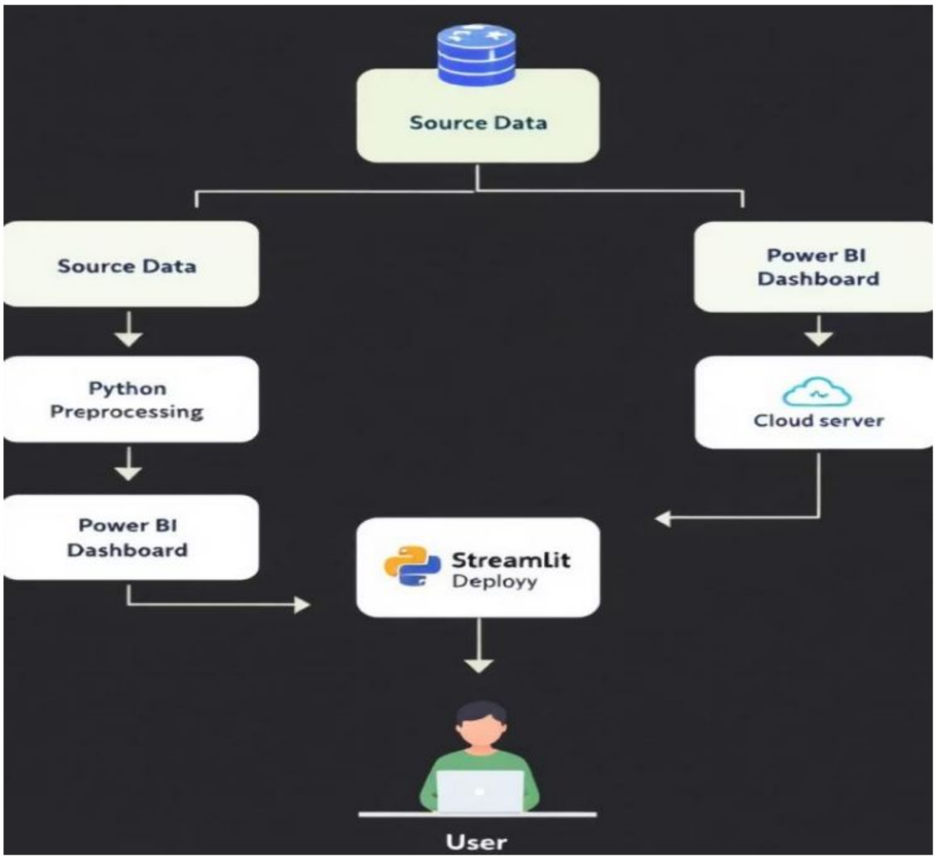
The development of the OEE Dashboard was an iterative process, progressing through several stages based on the available data, stakeholder feedback, and ongoing testing. The procedure can be broken down as follows:

1. Initial Data Collection (Excel Prototype):
   - The first stage involved collecting data in Excel. The raw data from the MSD logs was entered into a spreadsheet template, which included basic OEE calculations. This allowed us to quickly prototype the core KPIs and determine which variables were critical for EBPL.
   - Feedback Loop: After presenting the initial Excel prototype to the EBPL team, feedback was gathered regarding the clarity of visualizations and the types of insights required.
2. Data Preprocessing (Power Query):
   - Power Query was employed to clean and standardize the data, including handling issues like negative values, time format discrepancies, and missing values. This preprocessing step was necessary to ensure the data could be accurately analyzed.
   - Feedback Loop: After preprocessing the data, we shared cleaned reports with EBPL's team, and adjustments were made based on feedback to improve data quality and visualization.
3. Dashboard Development (Power BI):
   - With the cleaned data, we built interactive dashboards in Power BI. These dashboards displayed key metrics such as OEE, MTBF, MTTR, and machine performance over time. Features such as filtering by machine, shift, and downtime reasons were incorporated for deeper insights.
   - Feedback Loop: The Power BI dashboards were shown to both shop floor and management teams. Feedback focused on the need for more detailed drill-downs, shift comparisons, and simplified interface options.

4. Web Interface Integration (Streamlit):
    - The final dashboard was embedded into a Streamlit web application. This web app allowed management and shop floor operators to view live dashboards on mobile and desktop devices.
    - Feedback Loop: Streamlit integration was tested for usability, ensuring that users could easily navigate through the app and access the most relevant insights for their roles.

Throughout the process, feedback from Minutes of Meetings (MOMs) and stakeholders was used to refine the data processing, dashboard functionality, and interface. Regular iterations were conducted to ensure the solution met EBPL's needs for real-time, actionable data.

This methodology allowed the team to deliver a dynamic, user-friendly OEE Dashboard that directly addresses EBPL's operational challenges while ensuring the solution was scalable and adaptable to future data sources and requirements.


Source Data
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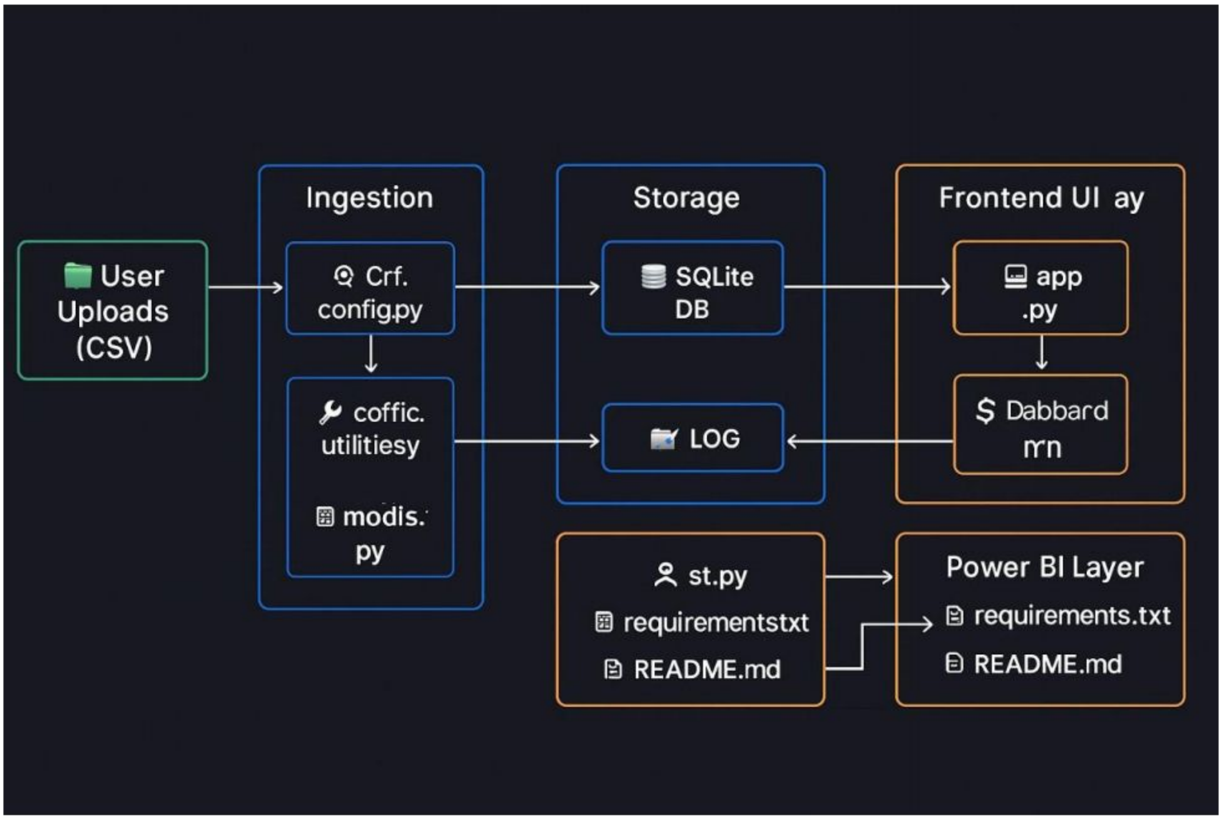
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# Chapter 10

# Implementation

The implementation of the OEE Dashboard for Eastern Bearings Pvt. Ltd. (EBPL) followed a structured, step-by-step approach focused exclusively on improving Overall Equipment Effectiveness (OEE) reporting. The project moved from manual Excel-based logs to a centralized, interactive dashboard system accessible in real-time by all stakeholders.

**Step-by-Step Implementation Process**

1. Requirement Gathering & Initial Study

- Conducted field visits and collaborative discussions with EBPL's production and quality teams.
- Analyzed the existing data formats, reporting gaps, and shift structures.
- Collected 6 months of data from the Grinding Department in Excel format, recorded manually by operators.
- Finalized KPIs to visualize: Availability, Performance, Quality, and OEE.

2. Excel Template Standardization

- Created a clean and structured Excel input format aligned with EBPL's workflow.
- Features included:
- Dropdowns for Machine ID, Shift, and Downtime Category
- Field protection to prevent accidental overwriting
- Data validation rules to reduce negative and incorrect entries
- Time input fields for Run Time, Downtime, and Planned Time

3. Data Preprocessing Using Power Query

Employed Power Query (in Excel and Power BI) to:

- Standardize inconsistent time formats (e.g., HH:MM vs decimal)
- Eliminate negative or null entries using rule-based filtering
- Add new columns for computed values like Effective Time, Shift Allocation, and Loss Time

- Apply custom shift-mapping logic based on EBPL's A/B/G shift system

4. OEE Metric Calculations

Implemented OEE component formulas within Power BI using DAX:

| |
|---|
| Availability (%) = (Run Time / Planned Time) × 100 |
| Performance (%) = (Ideal Cycle Time × Total Output) / Run Time × 100 |
| Quality (%) = (Good Count / Total Count) × 100 |
| OEE (%) = (Availability × Performance × Quality) / 10000 |

Each formula was embedded in a dynamic model, allowing real-time filtering by machine, date, or shift.

5. Dashboard Development in Power BI

Built multiple dashboard pages for:

- OEE Overview: Summary view across all machines
- Machine-Level View: Drill-down into individual equipment performance
- Shift Comparison: Visual comparison of OEE across shifts
- Anomaly Detection: Flagging of high/low/invalid entries

- Visualization elements:
  - Pie charts for Availability, Performance, Quality
  - Bar graphs for shift- and machine-wise OEE
  - Line chart with OEE target (55%) as a benchmark

6. Deployment Using Streamlit Web App

Integrated Power BI dashboards into a Streamlit interface for ease of access and simplicity.

Benefits:

- Device-independent access: mobile, tablet, desktop
- Lightweight front-end for faster loading
- Role-based usability (operators, supervisors, management)
- Hosted on a shared network or local server as per EBPL preference

## 10.2 System Architecture Diagram

[ Excel Input (MSD-aligned Format)]

↓

[ Power Query (Cleaning & Transformation) ]

↓

[ Power BI (OEE Calculations + Visualization) ]

↓

[ Streamlit Web App (Accessible Dashboard) ]

**Challenges and Solutions**

| Challenge | Details | Solution |
|---|---|---|
| Inconsistent Time Formats | Different input formats (HH:MM, decimals) caused misalignment | Standardized using Power Query time parsing logic |
| Negative / Null Entries | Frequent errors in manual entry | Highlighted using conditional formatting + validation rules in Excel |
| Incorrect Shift Assignments | Overlapping or misrecorded shifts led to confusion | Implemented shift segmentation logic during preprocessing |
| Mismatch Between Excel & MSD | Format mismatch and reporting delays | Adjusted Excel format to match MSD structure as recommended in Apr 12 meeting |
| User Experience in Power BI | Non-technical users faced difficulty navigating complex visuals | Embedded into a Streamlit front-end with simplified navigation and filters |
| Dashboard Performance | Dataset size (6 months) slowed dashboard | Applied column optimization and visual refresh delays to maintain responsiveness |

# Chapter 11

# Results and Discussion

The implementation of the OEE Dashboard at Eastern Bearings Pvt. Ltd. (EBPL) brought a measurable shift from traditional, manual reporting methods to a structured, automated, and visually intuitive monitoring system. The transformation was guided by practical, industry-focused feedback and shaped through an iterative development approach.

**Before vs After: Manual Process vs OEE Dashboard**

Before the initiation of this project, EBPL relied entirely on manual processes for performance tracking. Operators recorded machine performance data in physical logs or Excel files. These were later compiled into summary sheets by supervisors. However, this method was error-prone, time-consuming, and lacked consistency across shifts and departments. Calculations like OEE, MTBF, or MTTR were either performed manually (inconsistently) or not at all—leading to delayed decision-making and incomplete insights.

With the implementation of the automated OEE Dashboard, the system shifted to a more efficient and scalable model:

| Feature | Before (Manual System) | After (OEE Dashboard System) |
|---|---|---|
| Data Entry | Manual entry in handwritten logs or Excel | Structured, validated Excel templates |
| Error Detection | Errors identified after review (if at all) | Automated flagging of nulls, high values, and negatives |
| Visualization | No or static charts in Excel | Live, interactive graphs in Power BI |
| Metric Calculation | Manual formulas, often incorrect | Standardized OEE, MTBF, MTTR, Quality %, etc. |
| Reporting | Weekly or shift-end summary | Real-time, with filters by shift, machine, and date |
| Accessibility | Local Excel sheets, not shareable | Available online via Streamlit interface—viewable anywhere |
| Shift Insights | Not easily traceable | Dedicated shift-wise breakdown and performance views |

### Benefits for Management

Management at EBPL now benefits from real-time, transparent access to machine performance, enabling smarter planning and faster action. Some of the direct outcomes include:

- Immediate Performance Overview: Real-time tracking of OEE and component KPIs allows plant heads and directors to instantly evaluate the effectiveness of each machine.
- Shift-Wise Performance Comparison: With built-in filters, they can now analyze which shifts are underperforming and why—something that was impossible with prior systems.
- Root Cause Analysis Support: Categorized downtime data and visual trends of MTBF and MTTR help prioritize maintenance planning and resource allocation.
- Benchmark Awareness: A fixed OEE target of 55% is now visually embedded, allowing for daily comparisons against expected performance.
- Remote Accessibility: Through Streamlit and Power BI Service, management can access the dashboard on any device (laptop, mobile, tablet) even while off-site.

### Benefits for Operators and Production Team

The dashboard is not just a management tool—it also empowers operators and shop-floor leaders:

- Machine-Level Accountability: Operators can instantly see how their assigned machines are performing. This has improved ownership and awareness of productivity metrics.
- Visual Alerts: Errors such as null values or unusual entries are flagged in real-time, allowing operators to correct data before submission.
- Simplified Input Process: The redesigned Excel template standardizes entries using dropdowns, validations, and protected fields—ensuring clean data at the source.
- Reduction in Reporting Time: Operators no longer need to manually compile shift reports, freeing up time for operational tasks.

**Implementation of Feedback from Key Meetings**

The project's progression was driven by two major review checkpoints, both of which heavily influenced the final solution.

1. 25th January 2025 – **Project Presentation & Stakeholder Review**

During the initial demo and presentation at EBPL's Sonipat plant, the following key feedback was shared and implemented by the target date (15 Feb) as per the MOM:

| Requested Feature | Implemented Solution |
|---|---|
| Highlight null or wrong/high values | Implemented conditional formatting in Power BI to flag anomalies |
| OEE in Pie Chart with Availability, Performance & Quality % | Added donut charts for all three metrics |
| Show MTBF/MTTR trends and downtime by category | Built trend line charts and downtime pie charts for each machine |
| OEE Target Line (55%) | Incorporated horizontal benchmark line in OEE trend visuals |
| Bar Graphs for all KPIs | Bar charts added for OEE, Availability, Performance & Quality |
| 6-month Grinding Data Analysis | Full historical data processed, cleaned, and visualized |

This review meeting was pivotal, as it clarified both functional expectations and visualization requirements from the management team. The resulting dashboard was designed to meet these exact standards.

2. 12th April 2025 – **Final Review & System Enhancement Suggestion**

Upon presenting the completed dashboard, EBPL appreciated the work done and offered a forward-looking suggestion:

"Use the machine-generated data directly from the MSD system using the same format we've standardized."

This input forms the foundation of the next iteration, focused on:

- Automating data ingestion from the machine logging system.
- Replacing manual Excel input with direct MSD system integration.
- Keeping the Excel-like format intact to ensure operator familiarity while upgrading the backend process.
- Exploring use of Python and SQL pipelines for live data ingestion and processing.

**Summary of Results**

The project achieved its initial goal of creating a centralized, real-time OEE Dashboard while also preparing EBPL for future digital transformation. Through detailed feedback loops and continuous stakeholder involvement, the team not only delivered a working system but also aligned it closely with business needs, operator workflow, and management goals.

This real-world deployment has laid a scalable foundation that can evolve into a fully automated smart dashboard system, integrated directly with EBPL's machines and accessible across all levels of the organization.

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30+ Years
EASTERN BEARING DASHBOARD
Dashboard
OEE Analysis
Availability Analysis
Performance Analysis
Quality Analysis
Machine Wise Analysis
Filter
Avg OEE
67%
Avg Availability
76%
Avg Performance
92%
Avg Quality
93%
Average OEE
Average Availability
Average Performance
Average Quality
March
Refresh
Fullscreen


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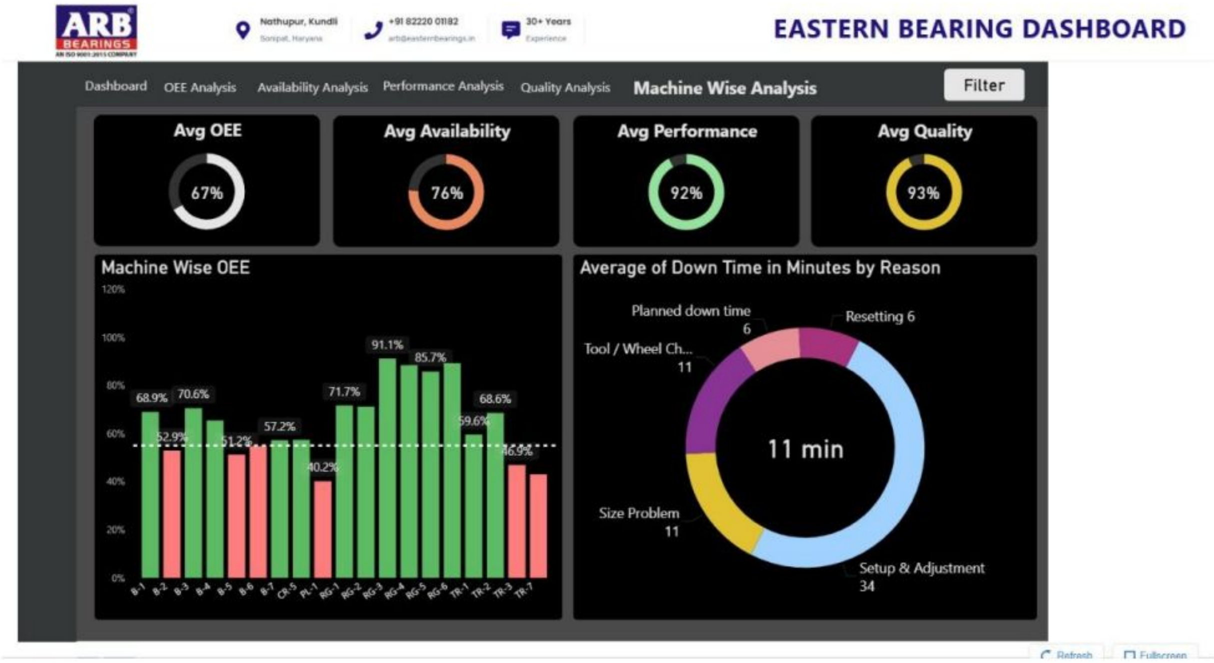
30+ Years
EASTERN BEARING DASHBOARD
Dashboard
OEE Analysis
Availability Analysis
Performance Analysis
Quality Analysis
Machine Wise Analysis
Filter
OEE Metrics Distribution
67.0%
Target 55%
Performance 92.28
Availability 75.73
Quality 93.08
Average OEE
March
Is OEE Data Valid?
Yes
Data Good to Analyze
Machine Wise Average OEE
TR-7 TR-3 TR-2 TR-1 RG-6 RG-5 RG-4 RG-3 RG-2 RG-1 PL-1 CR-5 B-7 B-6 B-5 B-4 B-3 B-2 B-1
Refresh
Fullscreen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Dashboard
OEE Analysis
Availability Analysis
Performance Analysis
Quality Analysis
Machine Wise Analysis
Filter
Avg OEE
67%
Avg Availability
76%
Avg Performance
92%
Avg Quality
93%
Machine Wise OEE
Average of Down Time in Minutes by Reason
Planned down time 6
Resetting 6
Tool / Wheel Ch... 11
11 min
Size Problem 11
Setup & Adjustment 34

# Chapter 12

# Conclusion & Future Work

The successful implementation of the OEE Dashboard at Eastern Bearings Pvt. Ltd. (EBPL) marks a major step forward in the company's journey toward data-driven manufacturing. The project achieved its core objective: to convert scattered, error-prone manual data into a real-time, centralized, and actionable dashboard that helps operators, supervisors, and management monitor and improve equipment effectiveness.

Through a structured process of data collection, cleaning, visualization, and deployment, the dashboard is now:

- Live and actively used by EBPL teams,
- Accessible anywhere, through a browser-based Streamlit interface,
- And providing clear insights into machine-wise and shift-wise performance.

By aligning the dashboard's design with the specific needs of EBPL and incorporating direct feedback from both the January 25th and April 12th meetings, the solution not only addressed immediate gaps but also set a scalable foundation for future innovation.

Future Work

While the current system delivers strong value, several opportunities exist to expand and enhance its capabilities:

- SQL Backend Integration
  Migrate from manual Excel inputs to a structured SQL database to allow centralized, scalable, and queryable data storage for production logs.
- Full Automation
  Automate the entire data pipeline—from machine log capture to dashboard refresh—using Python scripts, API integration, and scheduler tools, removing the need for manual Excel uploads.

- Department Expansion
  Extend the dashboard to other production areas (e.g., Assembly, Finishing, Quality Control), allowing organization-wide performance visibility beyond just the Grinding department.

- Predictive Maintenance Using ML
  Implement machine learning models to analyze historical data and predict potential breakdowns or downtime, shifting EBPL from reactive to proactive maintenance planning.

This project has laid the foundation for smart manufacturing at EBPL, and with continued iteration and automation, the system can evolve into a fully integrated, real-time operations intelligence platform.

# Chapter 13

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