Manufacturing Line Productivity Analysis Using Power BI Documentation

Project Overview

This project analyzes the productivity of a manufacturing line using Power BI. The objective is to gain insights into production efficiency and identify key downtime factors.

Project Scope

The scope of this project includes:

- Analyzing batch-level production data to assess productivity.

- Identifying downtime factors and their impact on production.

- Creating interactive Power BI visualizations to support data-driven decision-making.

Data Sources

The project uses the following data sources:

- **Line Productivity: Batch-level production data with product type, operator, and time details.**

- **Products: List of products with descriptions and minimum batch times.**

- **Downtime Factors: Description of various downtime reasons and whether they are operator related.**

- **Line Downtime: A Detailed record of downtime occurrences per batch.**

| Table	Field	Description
Line productivity		Fact table containing details for each batch produced
Line productivity	Date	Date the batch was produced **(Date)**.
Line productivity	Product	ID for the product produced in the batch **(Text)**.
Line productivity	Batch	Unique ID for the batch produced **(Whole Number)**.
Line productivity	Operator	Production line operator in charge of the batch **(Text)**.
Line productivity	Start Time	Time the batch production started **(Date/Time)**.
Line productivity	End Time	Time the batch production ended **(Date/Time)**.
Products		Dimension table with details on each product
Products	Product	Unique product ID **(Text)**.
Products	Flavor	Soda flavor for the product **(Text)**.
Products	Size	Product size (volume) **(Text)**.
Products	Min batch time	Minimum time required to produce a batch (with no downtime) **(Whole Number)**.
Line downtime		Fact table containing downtime (in minutes) by factor for each batch
Line downtime	Batch	Unique ID for the batch produced **(Whole Number)**.
Line downtime	Downtime factor	Downtime minutes for each factor ID (across columns) **(Text)**.
Downtime factors		Dimension table with details on each downtime factor
Downtime factors	Factor	Unique ID for each downtime factor **(Whole Number)**.
Downtime factors	Description	Downtime factor description **(Text)**.
Downtime factors	Operator Error	Is this due to operator error? (Yes/No) **(Text)**.

Data Preparation

Data preparation involved:

- Cleaning and transforming the data.

- Handling missing values.

- Merging datasets to create a comprehensive view.

- Creating New Table (Down Time for lines)

- Converting time fields into appropriate formats.

Data Modeling

- Fact Table: Line productivity.

- Dimension Tables: Products, Downtime Factors, Down Time for Lines.

- Relationships were established between fact and dimension tables to enable analysis.
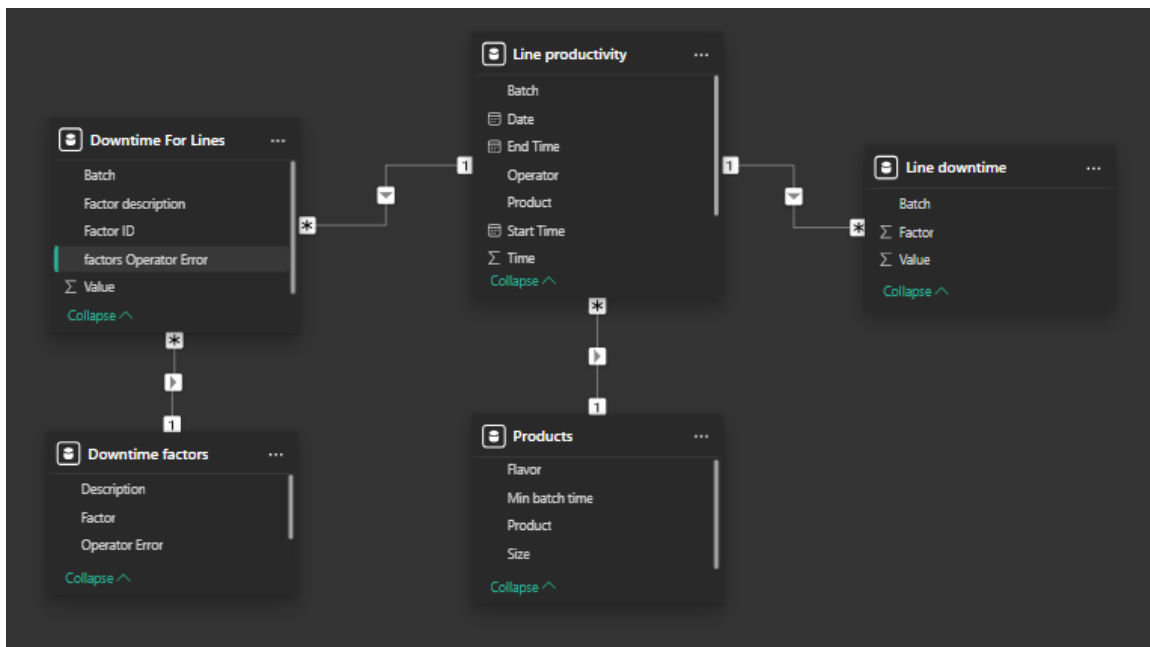
Analysis Tools

The following tools were used in the analysis:

- Power Query: Data transformation and cleaning.

- DAX (Data Analysis Expressions): Custom calculations and aggregations.

- Power BI Visualizations: Interactive charts, tables, and dashboards.

- Data Relationships: Establishing connections between tables.

- **Filters and Slicers: Enabling dynamic data exploration.**

Visualizations

- **Production Efficiency by Product.**

- **Downtime by Factor.**

- **Batch Time Comparison.**

Key Questions

Productivity Analysis

1. **What is the average batch production time compared to the minimum batch time for each product?**

2. **Which products have the highest production efficiency?**

3. **How does batch production time vary by operator?**

Downtime Analysis

4. **What are the most common downtime factors?**

5. **Which downtime factors contribute the most to overall downtime duration?**

6. **Is there a correlation between operator-related downtime factors and total downtime duration?**

Operator Performance

7. **Which operators have the fastest production times?**

8. **Which operators are associated with the highest number of downtime occurrences?**

9. **How does operator performance vary across different products?**

Time-Based Analysis

10. **Is there a pattern in downtime occurrences by time of day or day of the week?**

11. **Does batch production time improve over time (learning curve effect)?**

12. **What is the average downtime duration per batch?**

Key Insights

- **Top-performing products.**

- **Common downtime reasons.**

- **Correlation between operator errors and downtime.**

Challenges and Solutions

- **Data inconsistencies and missing values: Extensive data cleaning using Power Query to fill missing values and standardize formats.**

- **Establishing accurate relationships between tables: Careful data modeling with consistent keys and validation checks.**

- **Designing effective visualizations: Iterative design process with feedback loops to ensure clear and insightful charts.**

Conclusion

The Power BI report provides actionable insights into production efficiency and downtime management, helping to optimize manufacturing performance.