

GRADUATION PROJECT

PROJECT NAME

Manufacturing Downtime

TEAM MEMBERS

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PROJECT IDEA AND GENERAL DESCRIPTION

A Production Performance Booster that plans to improve manufacturing efficiency by analyzing production data. The project focuses on:

1. **Line productivity:** Tracks production batches
2. **Line Downtime:** Records when production stops and the reasons why.
3. **Downtime Factors:** The causes of Downtime (machine failure, operator errors...)
4. **Products:** which has the longest downtime

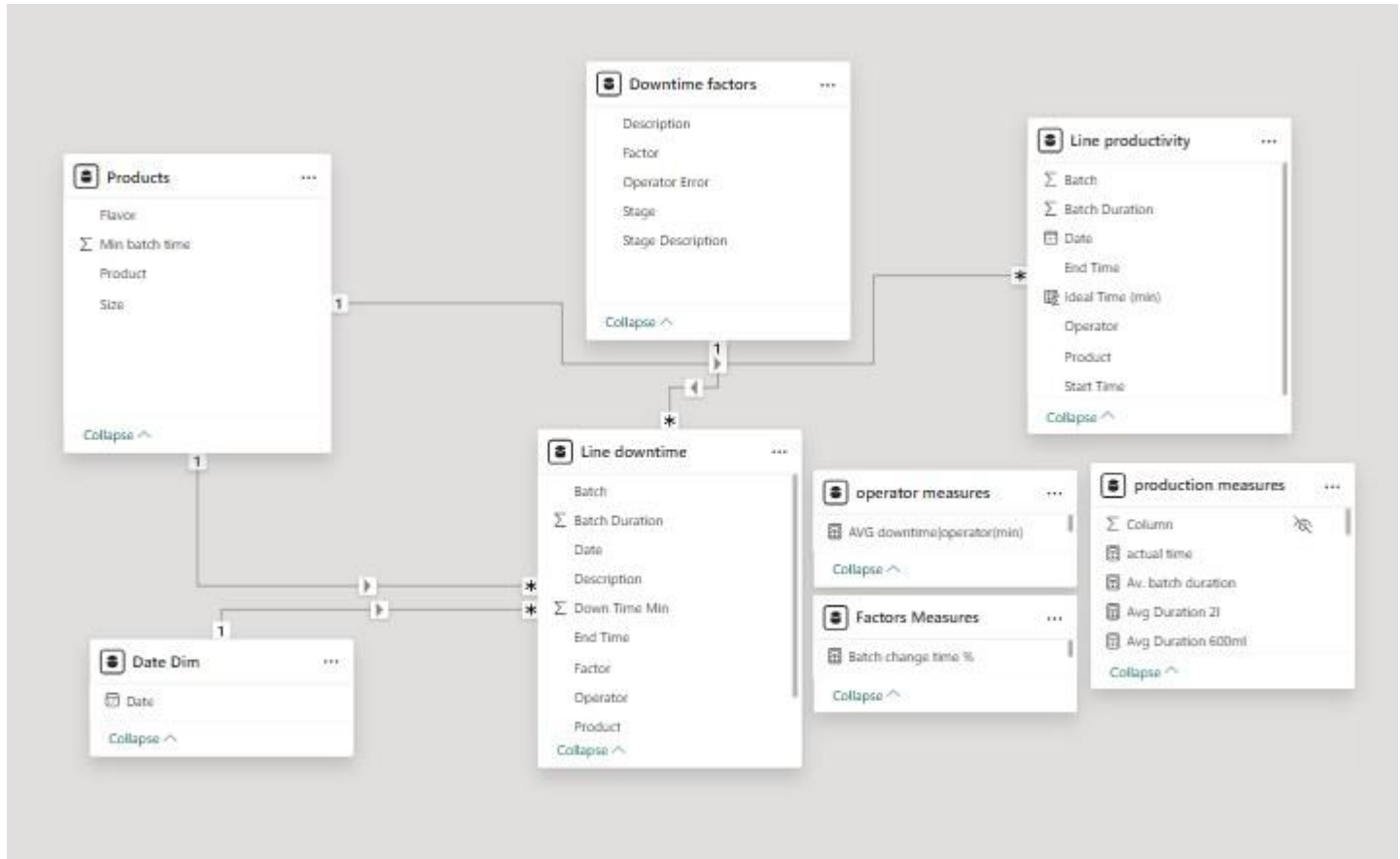
The goal is to identify key issues, such as frequent downtime causes (e.g., machine failures, operator errors), underperforming operators (Mac, Charlie, Dee, Dennis), and problematic products (OR-600, CO-600, CO-2L).

PREPROCESSING AND MODELLING

PREPROCESSING

- **Line downtime:** Unpivot the line downtime table to transform downtime factors from columns into **individual rows**.
- **Merging:** The two fact tables, line downtime and line productivity, are merged together to create a **unified view of production performance** that connects **output efficiency with causes of inefficiency**.
- **Line Productivity:**
 - **Batch Duration:** a custom column is created by calculating the time difference between the **Start Time** and **End Time** columns. This new column allowed us to measure the **actual runtime of each batch**, which was essential for analyzing efficiency and comparing it to expected performance.
 - **Ideal Time (min):** represents the **target duration** based on the product type and bottle size.
- **Downtime Factors:** Two custom columns were added:
 - **Stage Description:** a conditional column assigns descriptive labels based on the **Stage** value
e.g., If **Stage = 1**, then **Stage Description = Raw Material & Preparation**
 - **Stage:** a conditional column was added based on the stage description column.
- **Date Dimension:** allowed us to perform **time-based analysis** — such as tracking **production trends by day**.

MODELLING



In the **Modeling** phase, we built a **star schema** to organize our data for efficient reporting and analysis. The central **fact table** was the merged dataset combining **Line Productivity** and **Line Downtime**, which held key metrics like batch duration, ideal time, and downtime per batch.

We connected this fact table to related **dimension tables**, including a **Date Dimension** for time-based filtering and trend analysis, and other relevant fields like **Product** and **Operator**. Relationships were defined using appropriate keys, enabling us to create **interactive visuals** and **accurate aggregations** across all report pages.

ANALYSIS AND INSIGHTS

OVERVIEW PAGE

MEASURES AND VISUALS

1. AVG Batch Duration (min) : 101.53
2. No. Batches: 38
3. No. products: 6
4. No. sizes: 2
5. Most produced product: CO-600ml
6. No. Days: 5
7. No. Factors: 12
8. Exist Factors: 11
9. No. Operators: 4
10. Total working hours: 64.30

11. Total Downtime hours: 23.13
12. Downtime | working portion: 35.98%

FACTORS PAGE

MEASURES

1. Existed Factors: 11/12
2. Emergency Stop frequency: 0
3. Total Downtime (hours): 23.13
4. Downtime percentage: 20.25%
5. Factor Frequency: 61
6. Most frequent factor: Machine adjustment

VISUALS

1. Total Downtime Hour | Flavor
2. Factor Frequency
3. Table of Factors Analysis:

Stage	Stage Description	Description of Factors	Sum of Downtime (min)
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OPERATOR EFFICIENCY PAGE

MEASURES

1. Best Operator: Dennis
2. No. operators: 4
3. AVG Downtime | operator (min): 347

VISUALS

1. Operator error time % | operator
2. No. Batch by operator
3. Total batch duration by operator
4. Error frequency by operator

PRODUCTION PAGE

MEASURES

1. Production Time: 64.30
2. No. expected batches: 59
3. No. actual batches: 38
4. Ideal time 600ml(hour): 1
5. Actual Duration 600ml (hour): 1.56
6. Expected Batches 600ml: 52
7. No. actual batches 600ml: 33
8. Ideal Time 2L: 1.63
9. AVG Duration 2L: 2.56

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10. Expected batches 2L: 8
 11. No. actual batches 2L: 5
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VISUALS

1. Expected batches by day
2. No. batches by day
3. No. products
4. Production Efficiency vs production inefficiency

PRODUCT DOWNTIME ANALYSIS (Tooltip)

MEASURES

1. No. Batches: 38
 2. AVG Batch duration: 101.53
 3. Factor Frequency: 61
 4. Down/Working %: 35.98%
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VISUALS

1. Factor by description and operator error

RECOMMENDATIONS PAGE

RECOMMENDATIONS FOR OPERATORS :

- 1-Train to Handle Machine Failures Quickly
 - 2-Ensure Inventory is Checked Before Production
 - 3- Improve Attention in Labelling and Packaging
 - 4-Enhance Focus During Assembly and Processing Stages
 - 5-Receive Training in Quality Control Practices
 - 6-Provide regular training to all staff on when and how to use emergency stops safely.
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RECOMMENDATIONS FOR MACHINE RELATED PROBLEMS :

1- Labeling Error:

Schedule regular calibration and maintenance of labeling and coding machines.

Install a label verification camera system to detect and reject mislabeled items automatically.

2-Conveyor Belt Jam:

Clean and inspect conveyor belts daily to remove debris or product buildup.

Install jam detection sensors that trigger an automatic stop to prevent damage.

Optimize belt speed and alignment settings based on product type to reduce friction or bunching.

3- Inventory Shortage:

Implement a just-in-time (JIT) inventory alert system linked to production scheduling.

Require a pre-shift inventory checklist to verify all necessary inputs are on hand.

Improve communication between the warehouse and production teams through shared dashboards.

4-Machine Failure:

Launch a predictive maintenance program using machine usage data to preempt failures.

Maintain a spare parts inventory for critical machine components.

Train technicians in rapid fault isolation and structured troubleshooting procedures.

5. Emergency Stop:

Conduct a root cause analysis (RCA) after every emergency stop event.

Install warning indicators to reduce unnecessary emergency activations.