SEPTEMBER 2024

MANUFACTURING DOWNTIME

AN ANALYTICAL REVIEW OF DOWNTIME FACTORS AND THEIR IMPACT ON SODA PRODUCTION EFFICIENCY

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INTRODUCTION

This report provides the analysis result of the productivity and downtime data of a soda bottling production line. The dataset provides critical information on the operator, product, start and end times, and downtime factors for each production batch. Understanding how various factors contribute to downtime is key to identifying inefficiencies and improving operational performance of the production line.

PROBLEM

The primary challenge faced by this production line is frequent and prolonged downtime, which negatively impacts operational efficiency. The root causes behind downtime, whether operator-related or mechanical, are not well understood, leading to inconsistent productivity and efficiency across different batches.

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GOALS

1. **HOW** efficient is the current production line?
2. **WHICH** operators are underperforming?
3. **WHAT** are the leading causes of downtime?
4. **ARE** certain operators struggling with specific errors?

METRICS

1. **MINIMUM BATCH TIME** – Minimum time required to produce a batch (with no downtime)

2. **ACTUAL BATCH TIME** – Total time took to produce a batch (with downtime)

3. **EFFICIENCY** – Ratio of Minimum Batch Time and Actual Batch Time (in %)

4. **LINE DOWNTIME** – Minutes lost for each batch due to operator and/or mechanical errors

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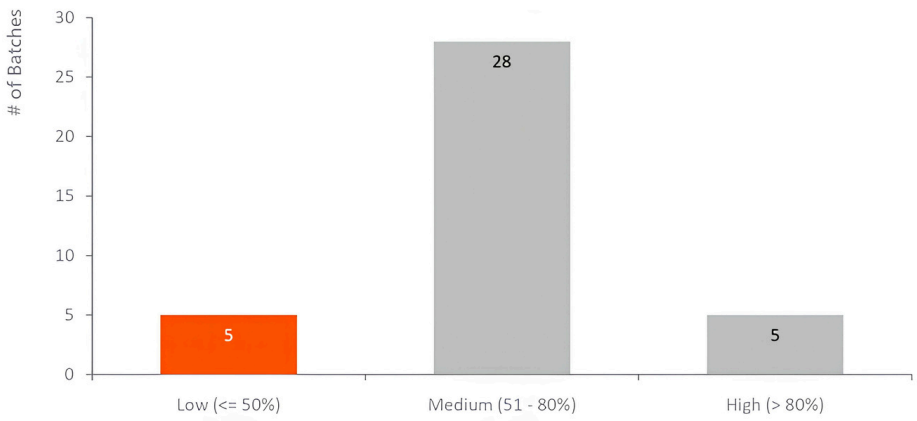
1. CURRENT LINE EFFICIENCY PATTERNS

"The current line efficiency is at 67.07%."

Efficiency Breakdown: Identifying the Bottlenecks

5 out of 38 batches have an efficiency score below 50%



Efficiency (%) = Min Batch Time * 100 / Actual Batch Time

Source: Manufacturing Downtime for a Soda Producing company from 29-08-2024 to 03-09-2024 (n=38 batches)

28 out of 38 batches are performing at a medium level of efficiency between 51 to 80%. Only **5** batches have an efficiency score below 50%, signaling potential problems in the production process.

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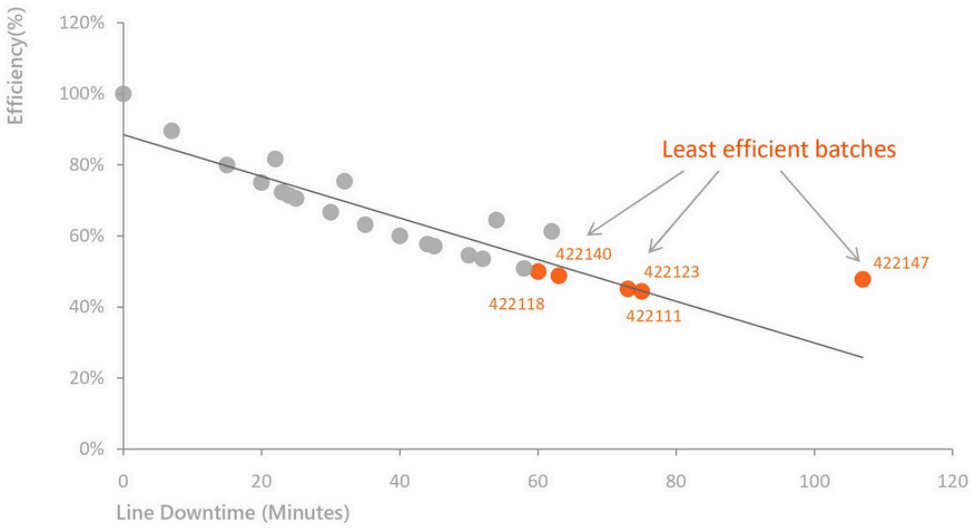
Efficiency has an Inverse Relation with Line Downtime

The least efficient batches of productions have a high downtime



Source: Manufacturing Downtime for a Soda Producing company from 29-08-2024 to 03-09-2024 (n=38 batches)

The negative linear relationship between efficiency and downtime suggests that **high downtime is the primary reason for lower efficiency**. As downtime increases, the production time grows, reducing efficiency.

The correlation score between line efficiency and downtime is **-0.9053** suggesting a strong negative correlation. However, correlation doesn't always mean causation.

***Downtime** is a major culprit in reducing efficiency.*

2. IDENTIFYING UNDERPERFORMING OPERATORS

Operator Performance Statistics

HIGH | LOW

Operators	Total Downtime (Minutes)	Average Downtime (Minutes)	Total Batch Time (Minutes)	Average Efficiency (%)
Charlie	384	35	1158	71%
Dee	370	34	1030	67%
Dennis	302	38	820	66%
Mac	332	42	850	63%

Source: Manufacturing Downtime for a Soda Producing company from 29-08-2024 to 03-09-2024 (n=38 batches)

Charlie has the highest downtime (**384 mins**) but a mid-range average downtime (35 mins per batch). **Mac** has the highest average downtime per batch (**42 mins**).

Even though Charlie has the highest total downtime, his batches are relatively more efficient on average compared to Mac's. This pattern indicates that Mac might be facing more severe production interruptions per batch, which could be linked to specific downtime factors.

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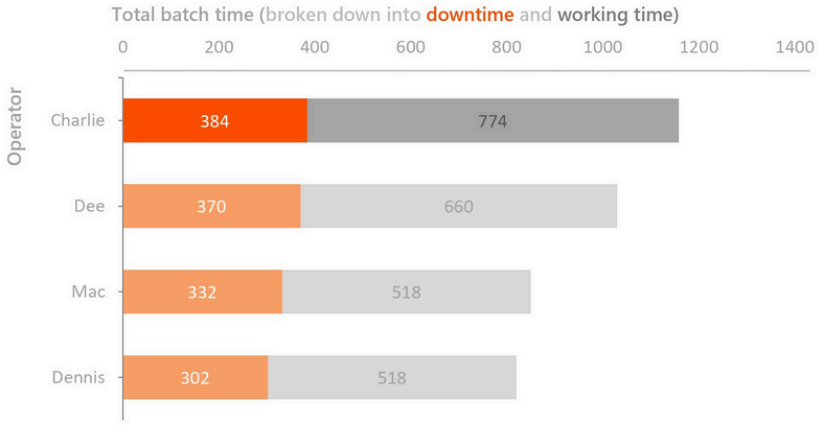
Operator Downtime

Charlie experiences the highest downtime. Operators lose on average 36% of their batch time to delays.



Source: Manufacturing Downtime for a Soda Producing company from 29-08-2024 to 03-09-2024 (n=38 batches)

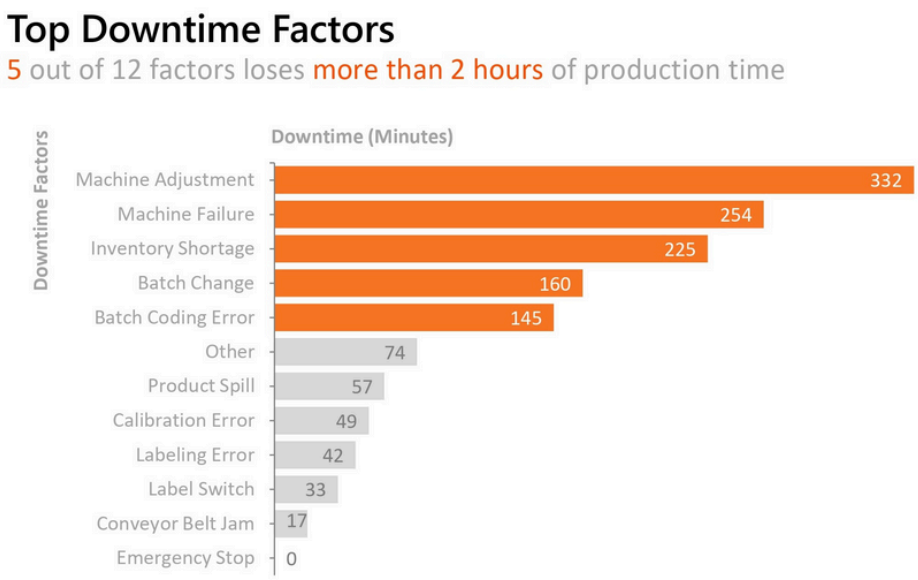
"The operators spend on average 36.24% of their total time in production delays."

The breakdown of total batch time into downtime and working time reveals that the downtime is roughly **proportional** to total batch time. In general, as an operator runs a production line longer, he/she will most likely face longer downtime.

Identifying the factors responsible for long downtime will help us reduce the percentage of downtime and increase overall productivity.

***Mac** is likely underperforming. All the operators spend around **one third** of their time in production delays.*

3. LEADING FACTORS FOR DOWNTIME



Source: Manufacturing Downtime for a Soda Producing company from 29-08-2024 to 03-09-2024 (n=38 batches)

"80.4% of total downtime are lost due to the top 5 factors."

Five out of twelve downtime factors account for **1116 minutes**, or **18.6 hours** (80.4% of total downtime) lost to line downtime due to operational errors.

Interventions will have the biggest impact on improving efficiency in **machine adjustment, machine failure, inventory shortage, batch change** and **coding error.**

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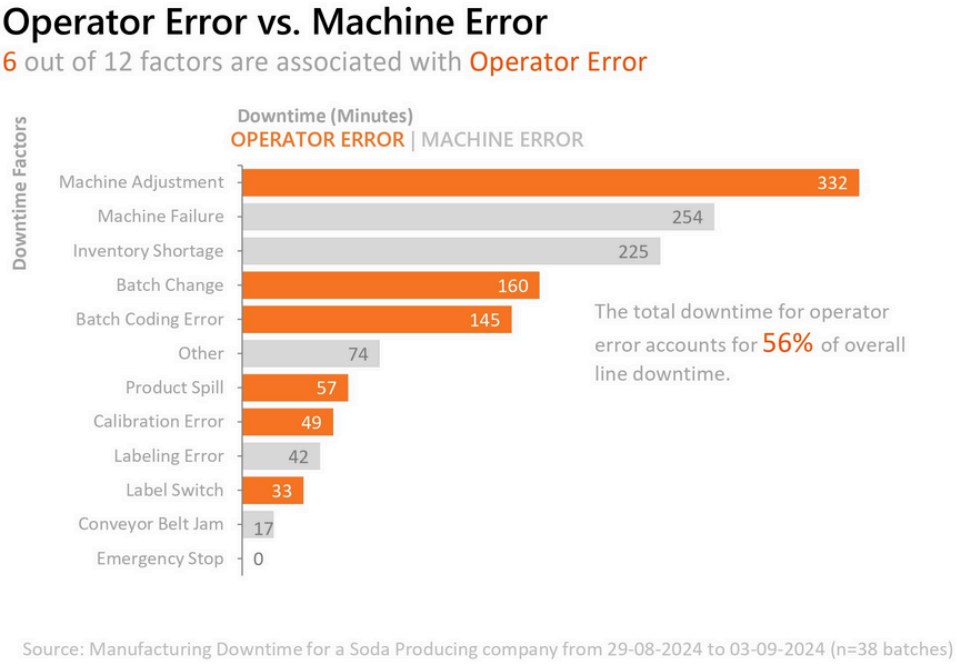


Source: Manufacturing Downtime for a Soda Producing company from 29-08-2024 to 03-09-2024 (n=38 batches)

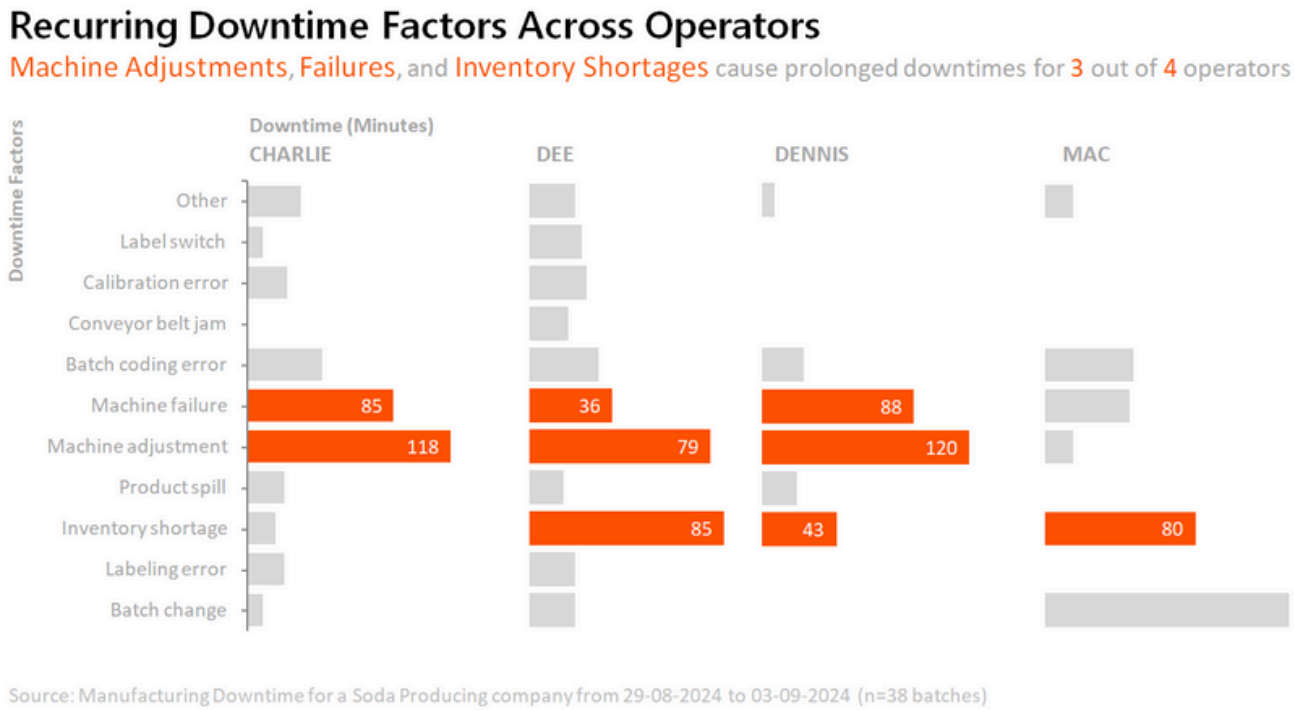
"According to data, 56% of total downtime is associated with operator errors."

Among the 12 leading downtime factors **6** are associated with operator error. Operators are struggling with **adjusting machines, changing batches, batch coding, product spill** and **calibrating errors**.

This shows that human factors are a bigger source of downtime for this production line.

***Operator-related** issues account for a significant portion of downtime.*

4. OPERATORS STRUGGLING WITH SPECIFIC ERRORS



CHARLIE

Struggles with a wide range of factors (10 out of 12), particularly with **Machine Adjustment** and **Batch Coding Error** (both tied to operator error). His frequent engagement with operator-related issues suggests a need for additional training or process improvements in handling machines and coding errors.

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DEE

Faces downtime across 11 factors, similar to Charlie, with **Machine Adjustment** and **Batch Coding Error** being primary issues. Her broad struggles mirror Charlie's, pointing to possible systemic issues in operator training for handling machine adjustments and coding.

DENNIS

His primary issues are **Machine Adjustment** and **Machine Failure**, but his downtime is spread across fewer factors (6 of 12). He might benefit from focused attention on managing machine adjustments.

MAC

Struggles with **Batch Change** (130 mins), who has the highest average downtime, and other operator-related issues (Batch Coding Error). Mac's high downtime from Batch Changes suggests he's particularly inefficient at managing transitions between batches.

Three key downtime factors across all the operators are ***machine adjustments, machine failures,*** *&* ***inventory shortages****.*

SUMMARY

HOW efficient is the current production line?	• The current line efficiency is **67%**. • **Downtime** has a strong negative correlation with efficiency (-0.9053). • An average one-hour batch faces **36 minutes** of downtime.
WHICH operators are underperforming?	• **Charlie** has the highest total downtime (384 mins) but moderate average downtime (35 mins/batch). • **Mac** is the least efficient operator (63%) with an average downtime of 42 mins per batch. • Operators spend **36.24%** of their total time in production delays.
WHAT are the leading causes of downtime?	• **Batch changes** and **machine adjustments** are frequent operator-related issues causing major downtime. • **Machine failures** and **inventory shortages** contribute significantly to downtime but are not operator errors.
ARE certain operators struggling with specific errors?	• Most operators are affected by **machine adjustments, failures,** and **inventory shortages**.

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RECOMMENDATIONS

1. **FOCUS** on **minimizing Machine Adjustments, Failures,** and **Inventory Shortages**, as these factors significantly contribute to downtime.

2. **PROVIDE** **targeted training** for operators like Mac and Charlie, to reduce downtime associated with operator errors like Batch Change and Machine Adjustment.

3. **CONSIDER** **adjusting batch schedules** to balance workloads and minimize downtime for operators like Mac, who experience high average downtime, and improve overall efficiency across the line.

4. **INTRODUCE** **preventive maintenance strategies** and **proactive interventions** for frequent machine-related issues to reduce unexpected downtimes.

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THANK YOU

Report created by **Arpita Deb**
Maven Analytics Data Challenge - **Manufacturing Downtime**
Article on **Medium**