Emerson x DAPH National Data Challenge

PROJECT BACKGROUND

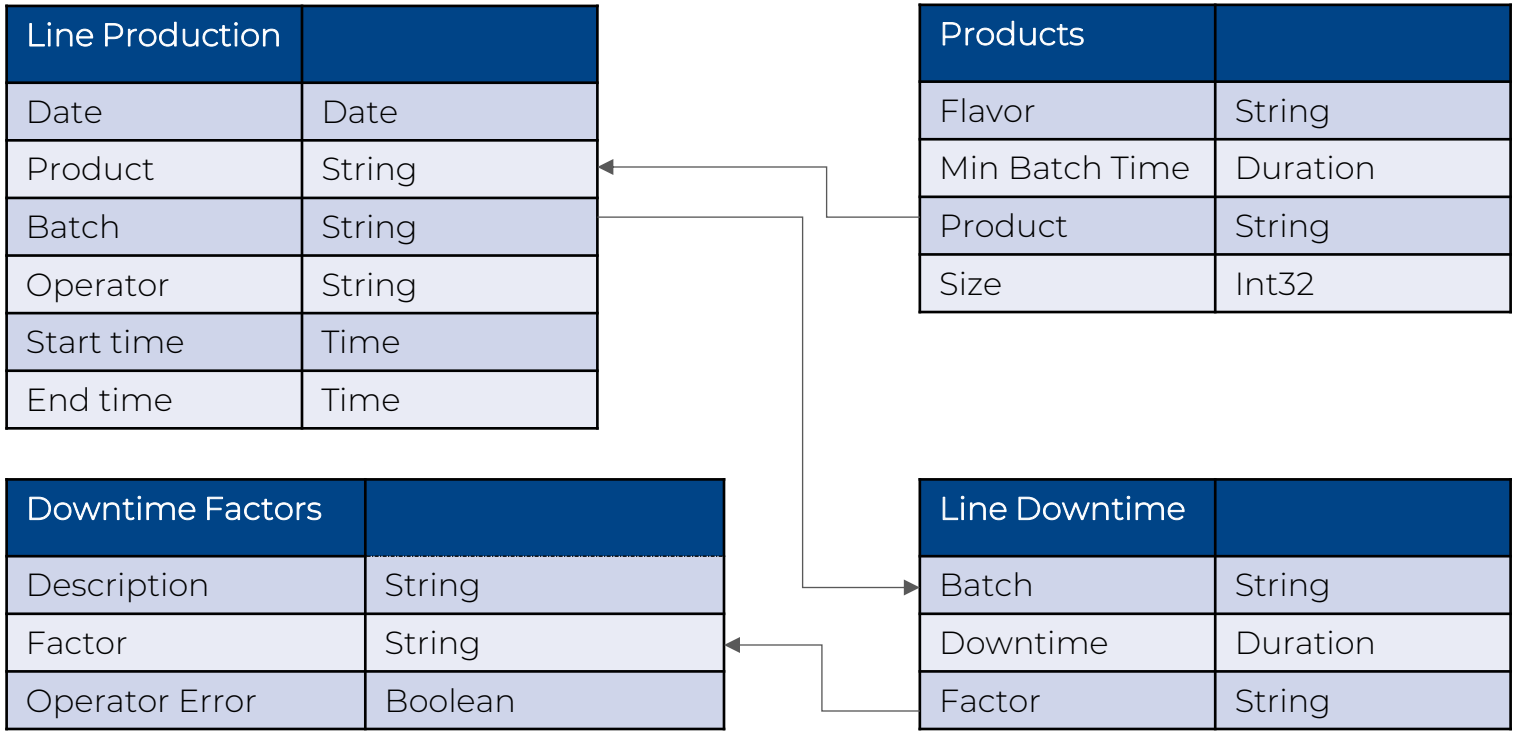
Developed as part of the **Emerson x Data Analytics Philippines Challenge**, this project features a dynamic and insightful dashboard built from real-world manufacturing line data.

The **primary objective** was to design a **production-ready analytics dashboard** that not only surfaces **critical operational insights** but also serves as a testament to our **data analytics expertise**—from data wrangling and visualization to actionable interpretation tailored for industrial decision-making.

PROJECT WORKFLOW

DATA STRUCTURE & INITIAL CHECKS

Manufacturing Line Productivity dataset structure as seen below is an excel workbook consists of 4 sheets: Line Production, Products, Downtime Factors and Line Downtime with a total of row count of 117 records.



The **Line Production** table is central, linking to Products via Product, and to Line Downtime via Batch, which in turn connects to Downtime Factors through Factor. With only 117 rows across all sheets, the dataset is small, the only issue is a pivoted table need some transformation, there are no missing or duplicated values.

EXECUTIVE SUMMARY

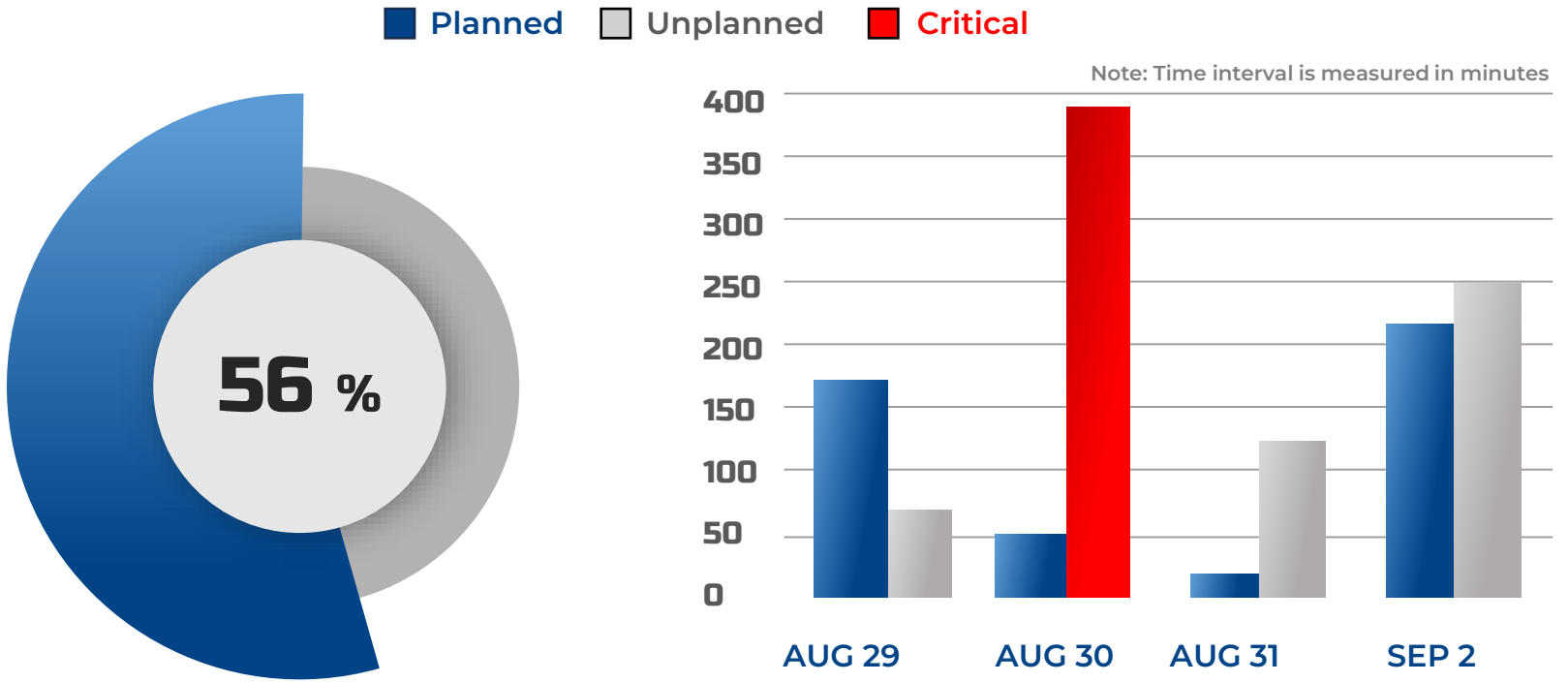
Overview of Findings:

The production line is experiencing significant performance challenges, primarily driven by unplanned downtimes, which account for a substantial **56% of the total operating time**. Over half of these downtimes are attributed to **machine failures** and **inventory shortages** often requiring frequent **machine adjustments** and additionally **prolonged batch changeovers** both contributed to **36% of the total downtime**, further compounding the issue.

As a result, the team is frequently required to work **overtime** to meet scheduled production targets, highlighting the urgent need for **operational improvements**.

DATA ANALYSIS

Over the **4-day production period**, **total downtime exceeded 50%** of the total operational time, with the majority attributed to recurring **machine failures** and **inventory shortages**, along with several minor unplanned interruptions. Notably, **74 minutes of downtime** were recorded under the "Others" category, indicating **unclassified or untracked issues that may require further investigation.**



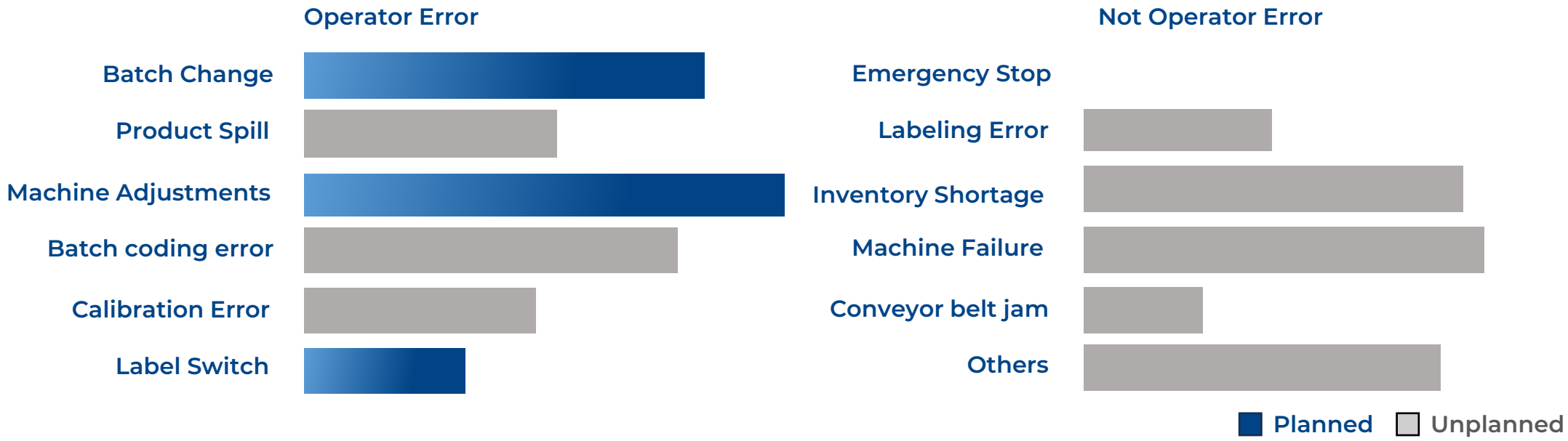
In addition to an unusually long planned downtime due to batch changes on August 29, and the unclassified 74 minutes of downtime, **the most critical concern** is the series of random **machine failures observed between batch processes on August 30**. Even more concerning is the **recurrence of failures after machine adjustments on September 2**, which **strongly suggests that the equipment may be approaching end-of-life** or in need of replacement.

Furthermore, the **persistent inventory shortages** point to potential **inefficiencies or disruptions in the supply chain**, as materials consistently fall short of production requirements. These issues collectively highlight an **urgent need for equipment reliability improvements and supply chain optimization.**

DATA ANALYSIS

The **primary contributors to total downtime** are **Machine Adjustments, Batch Changes, Machine Failures,** and **Inventory Shortages**. Notably, two of these—**Machine Adjustments** and **Batch Changes**—are currently categorized under **Operator Error**, despite being **planned downtimes** related to routine maintenance and operator shift transitions. This classification **unfairly skews operator performance metrics** and should be **re-evaluated**, as it may inaccurately reflect on operator efficiency.

Additionally, **Labeling Errors** should be classified as **Operator Error**, given that they directly result from **improper label switching**, a task within the operator's responsibility. Clear categorization will ensure more accurate performance assessments and help target the appropriate areas for process improvement.



While **product type is not a direct cause of downtimes**, it indirectly reflects **inefficiencies or disruptions within the supply chain**. The leading contributor to downtime—**Machine Adjustments**—is often a **consequence of recurring machine failures**, reinforcing the need to prioritize **equipment reliability and maintenance strategies**.

Moreover, **Batch Changes**, which rank as the second highest contributor to total downtime, frequently occur **in conjunction with inventory shortages and machine failures**, suggesting that these issues are interrelated. This further emphasizes that the **two most critical areas requiring immediate attention are machine failures and supply chain disruptions**, as they trigger a cascading effect on multiple downtime categories.

RECOMMENDATIONS

01 Machine Failures

Equipment replacement should be considered, as frequent failures are significantly impacting production performance and overall efficiency.

02 Inventory Shortages

Evaluate and address supply chain inefficiencies to minimize disruptions and prevent production delays.

03 Operator training

Although operator errors are minimal, reducing human error remains essential to maximizing overall production efficiency.

04 Investigate Anomalies

Investigate unclassified downtimes, as they may uncover underlying issues that could impact future production performance.

05 Domino Effect

Implementing Recommendations 1–4 will address key root causes, which in turn resolve several interconnected issues. By focusing on these critical areas, overall production performance is expected to improve significantly.

ASSUMPTIONS AND CAVEATS

Throughout the analysis, multiple assumptions were made to manage challenges with the data. These assumptions and caveats are noted below:

- The **batch runtimes is effectively the sum of minimum batch time and downtime.** However, this creates challenges when applying standard Key Performance Indicator (KPI) formulas. The **minimum batch time represents the ideal time required to produce a batch without any interruptions**, it is assumed min batch time are runs without errors and not the ideal time. To avoid misinterpretation, especially since many KPI formulas rely heavily on the concept of **ideal time**, I deliberately avoided using KPI metrics in this analysis to maintain clarity and accuracy.
- **Daily production start times are inconsistent**, with no fixed interval observed. As the dataset provides no explanation for this variability, it was ignored from the analysis.
- There is a **one-day data gap (Sunday)**, and **September 3 only reflects overtime work carried over from September 2**. Additionally, the data is **not continuous**, with production running only **8 to 10 hours per day** over a total span of approximately **2.6 actual production days**. Due to this limited and irregular data coverage, **hourly breakdowns and the use of slicers were avoided**, as they would offer little analytical value and may lead to misinterpretation.
- The dataset did not specify which downtimes were **planned or unplanned**. For the purpose of analysis, I assumed that **Machine Adjustments** (maintenance), **Batch Changes**, and **Label Switches**—as part of regular production routines—are **planned downtimes**. All other downtime events were classified as **unplanned**.
- The **criteria for scheduling specific products for production** were not specified in the dataset. It is **assumed** that production scheduling is **driven by demand**, although no explicit data was available to confirm this.

DESIGN

01

Shows production critical KPI that indicates overall **Production Line Health.** Helps track overall health and performance at a glance.

02

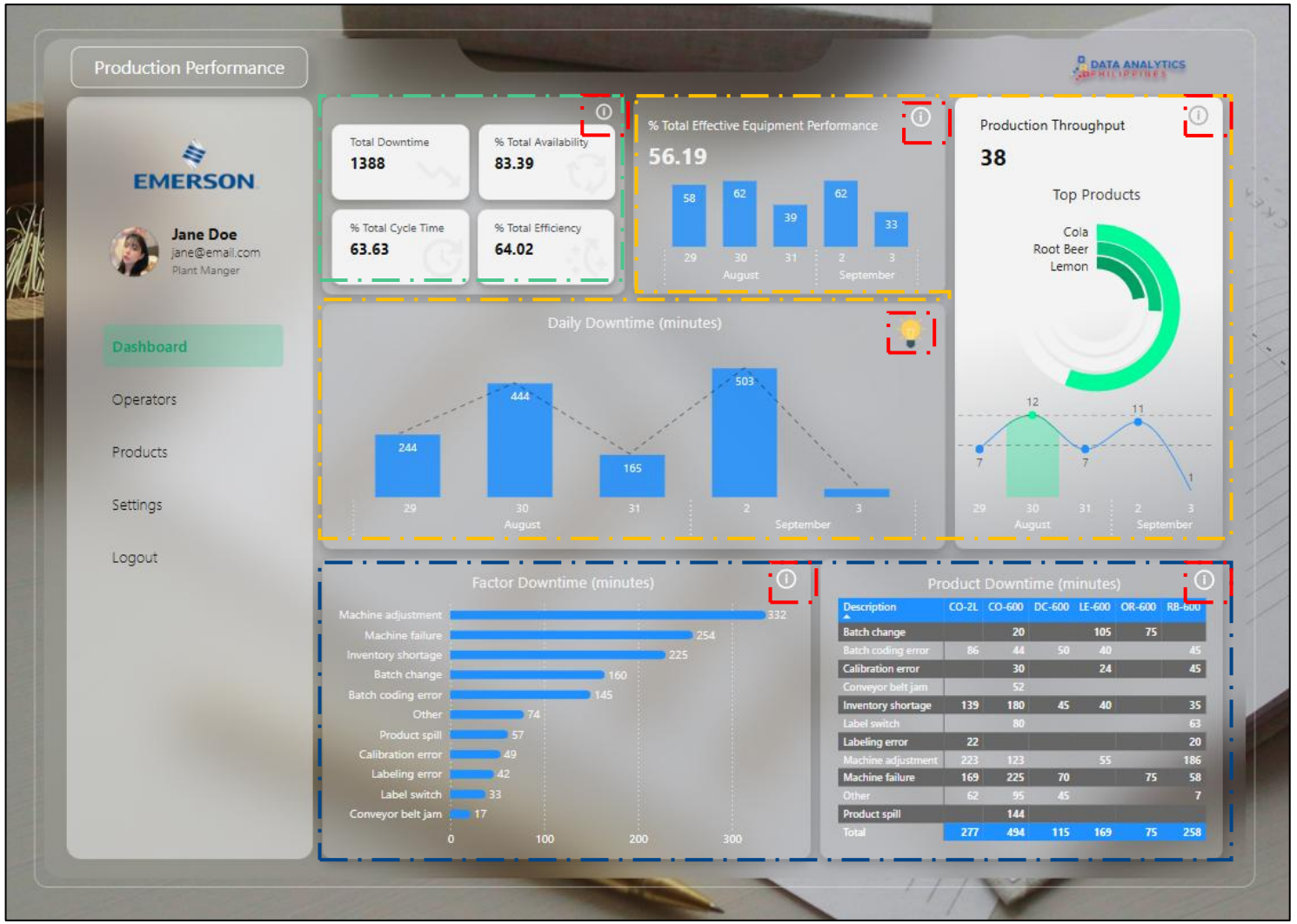
KPI that is more meaningful when have a daily breakdown for a quick overview of daily breakdown of **equipment performance, batches produced and downtimes**

03

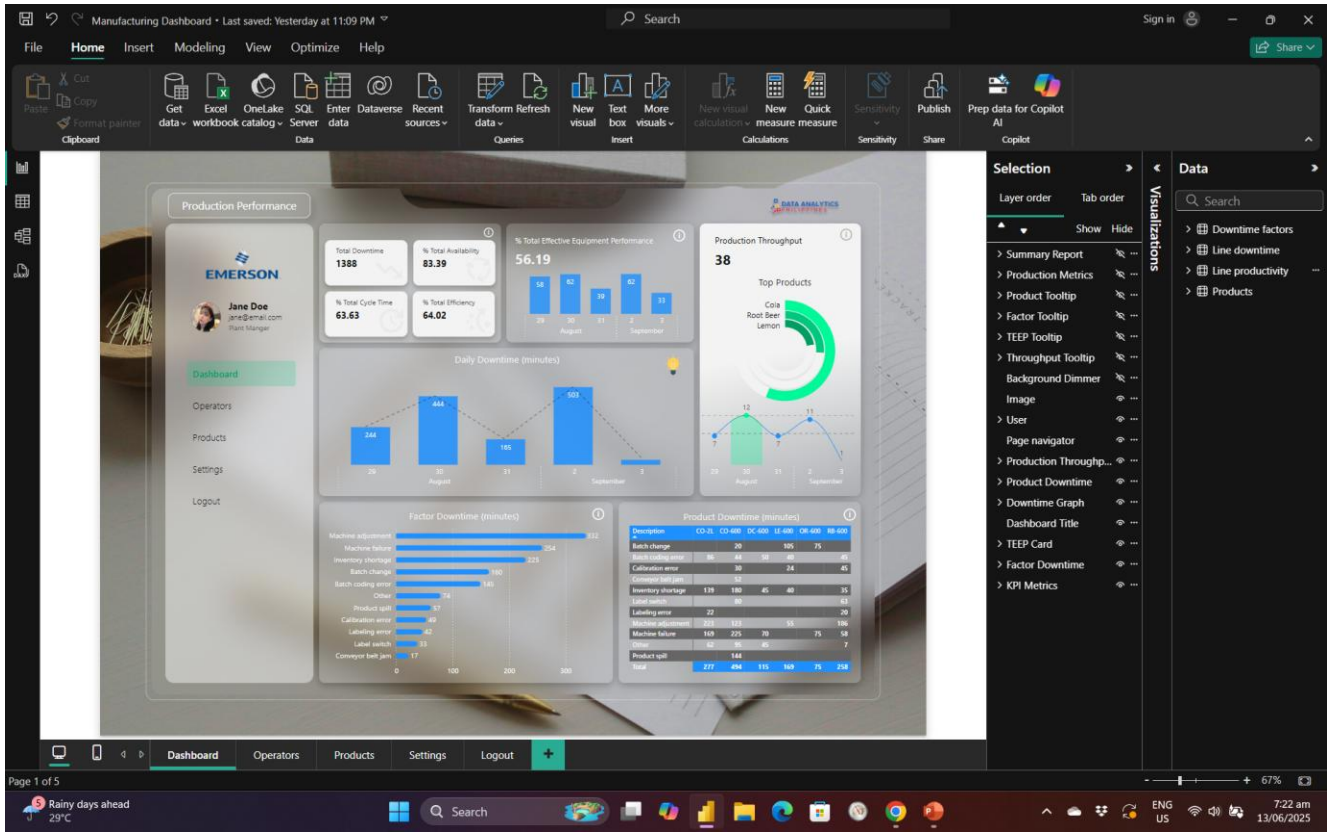
Downtime factors breakdown for a granular explanation of which factors contributes most to the problem and what factors affected our productions per product.

04

Info button for context in consideration for people who doesn't have any domain knowledge about the KPI shown, **breaks down the explanation to what it shows and its purpose,** explained in a manner that a 5 years old can understand



DESIGN



- A **uniform 10 pt padding** was applied around each container, along with a **10 pt internal margin** within each graph and visual. This ensures consistent spacing, allowing each element room to "breathe" without clutter. The layout creates a **clean, organized appearance**, offering a **subtle illusion of spaciousness** while maintaining a **compact and accessible visual structure**, with all key visuals comfortably within the viewer's eye range.

- All design layers have been **systematically organized** to support **future collaboration and seamless handovers**. This structure ensures that **other designers can easily navigate, modify, or build upon the project**, facilitating efficient updates and design changes.

- The dashboard follows a **modern minimalist design**, utilizing a **glassmorphism-inspired UI** to achieve a sleek and elegant finish. To maintain a clean and uncluttered interface, **supporting details are tucked into info buttons**, allowing users to access additional information on demand. The dashboard is designed to be **visually adaptive**, blending seamlessly with various wallpapers and background themes for a cohesive and refined user experience.

HIGH RESOLUTION SCREENSHOT

Description	CO-2L	CO-600	DC-600	LE-600	OR-600	RB-600
Batch change		20		105	75	
Batch coding error	86	44	50	40		45
Calibration error		30		24		45
Conveyor belt jam		52				
Inventory shortage	139	180	45	40		35
Label switch		80				63
Labeling error	22					20
Machine adjustment	223	123		55		186
Machine failure	169	225	70		75	58
Other	62	95	45			7
Product spill		144				
Total	277	494	115	169	75	258


THANK
YOU