DOCUMENTATION

MANUFACTURING LINE PRODUCTIVITY

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CHAPTER (ONE)

INTRODUCTION

OBJECTIVES:

- COMPREHENSIVE PRODUCTIVITY ANALYSIS: STUDYING THE BEVERAGE PRODUCTION LINE FROM START TO FINISH AND IDENTIFYING OPPORTUNITIES FOR IMPROVEMENT TO INCREASE EFFICIENCY AND REDUCE WASTE.
- IDENTIFYING OPPORTUNITIES TO IMPROVE EFFICIENCY: FOCUSING ON PROCESSES THAT CAN BE MODIFIED OR IMPROVED, SUCH AS REDUCING UNNECESSARY DOWNTIME AND OPTIMIZING LABOR UTILIZATION.
- LEVERAGING OPERATIONAL DATA: USING OPERATIONAL DATA FROM AUGUST TO SEPTEMBER 2024 TO PROVIDE ACTIONABLE INSIGHTS FOR PERFORMANCE IMPROVEMENT.
- ACHIEVING MEASURABLE RESULTS: SUCH AS REDUCING PREVENTABLE DOWNTIME, IMPROVING OVERALL EQUIPMENT EFFECTIVENESS (OEE), AND INCREASING PRODUCTION CAPACITY.

INTRODUCTION

THE BEVERAGE MANUFACTURING INDUSTRY IS HIGHLY COMPETITIVE, AND ACHIEVING OPERATIONAL EXCELLENCE IS KEY TO SUSTAINING PROFITABILITY AND ENSURING LONG-TERM SUCCESS. IN THIS REPORT, WE FOCUS ON ANALYZING THE PRODUCTIVITY OF THE MANUFACTURING LINE, AIMING TO UNCOVER CRITICAL OPPORTUNITIES TO ENHANCE EFFICIENCY, REDUCE OPERATIONAL WASTE, AND OPTIMIZE LABOR UTILIZATION. THE ANALYSIS LEVERAGES OPERATIONAL DATA GATHERED FROM AUGUST TO SEPTEMBER 2024, PROVIDING A CLEAR VIEW OF THE PRODUCTION LINE'S CURRENT PERFORMANCE.

PRODUCTIVITY CHALLENGES SUCH AS EQUIPMENT DOWNTIME, OPERATOR INEFFICIENCY, AND BOTTLENECKS IN SPECIFIC PRODUCTION STAGES ARE IMPACTING OVERALL EFFICIENCY

KEY AREAS IDENTIFIED FOR IMPROVEMENT INCLUDE REDUCING PREVENTABLE DOWNTIME, IMPROVING OVERALL EQUIPMENT EFFECTIVENESS (OEE), AND STREAMLINING PRODUCTION PROCESSES ACROSS SHIFTS. THE PRIMARY FOCUS IS ON ADDRESSING RECURRING ISSUES SUCH AS BATCH CHANGEOVERS, MACHINE ADJUSTMENTS, AND INVENTORY SHORTAGES, ALL OF WHICH CONTRIBUTE TO UNNECESSARY DELAYS AND PRODUCTION INCONSISTENCIES. THROUGH DATA-DRIVEN INSIGHTS, THIS REPORT IDENTIFIES THE ROOT CAUSES OF INEFFICIENCIES, PROVIDING ACTIONABLE RECOMMENDATIONS AIMED AT IMPROVING THE MANUFACTURING LINE'S OVERALL PRODUCTIVITY.THE KEY PAIN POINTS IDENTIFIED INCLUDE SIGNIFICANT DOWNTIME DUE TO CHANGEOVERS AND OPERATOR ERRORS.

STRATEGIES. QUICK WINS, SUCH AS REDUCING CHANGEOVER TIMES AND IMPROVING OPERATOR TRAINING, ARE TARGETED FOR IMPLEMENTATION IN THE IMMEDIATE FUTURE, WHILE MORE STRATEGIC INITIATIVES LIKE INVESTING IN AUTOMATED CHANGEOVER SYSTEMS AND PREDICTIVE MAINTENANCE PROGRAMS ARE OUTLINED FOR A LONGER TIME FRAME.

THE OUTCOMES OF IMPLEMENTING THESE STRATEGIES INCLUDE SUBSTANTIAL COST SAVINGS, INCREASED PRODUCTION CAPACITY, AND A MORE STANDARDIZED APPROACH TO PRODUCTION PROCESSES. BY FOCUSING ON CONTINUOUS IMPROVEMENT AND LEVERAGING OPERATIONAL DATA, THIS REPORT PRESENTS A ROADMAP FOR OPTIMIZING MANUFACTURING PRODUCTIVITY AND ACHIEVING SIGNIFICANT OPERATIONAL GAINS.

CHAPTER (TWO)

DATA CLEANING

OBJECTIVES:

- IMPROVE DATA QUALITY: ENSURE THAT THE DATA IS FREE FROM ERRORS AND ISSUES THAT COULD AFFECT THE ACCURACY OF ANALYSIS AND RESULTS.
- REMOVE INVALID DATA: ELIMINATE MISSING, INACCURATE, OR INCOMPLETE DATA THAT COULD LEAD TO MISLEADING RESULTS.
- ELIMINATE DUPLICATES: IDENTIFY AND REMOVE DUPLICATE RECORDS TO ENSURE THAT EACH ENTRY IN THE DATA REPRESENTS A UNIQUE VALUE.
- CORRECT ERRORS: ADDRESS ERRORS IN THE DATA, SUCH AS OUTLIERS OR ILLOGICAL VALUES, WHICH COULD AFFECT THE ANALYSIS.
- TRANSFORM DATA INTO AN ANALYZABLE FORMAT: CONVERT DATA INTO THE CORRECT FORMAT, SUCH AS CHANGING DATE FORMATS OR CONVERTING TEXT VALUES TO NUMERIC ONES IF NECESSARY.

LINE PRODUCTIVITY DATA CLEANING AND TRANSFORMATION

STEPS TAKEN:

REMOVING NULL COLUMNS:

REMOVED COLUMNS WITH NULL VALUES TO ELIMINATE UNNECESSARY DATA.

REMOVING NULL ROWS:

DELETED ROWS WITH NULL VALUES TO ENSURE THE DATA IS COMPLETE AND ACCURATE.

CALCULATING ACTUAL DURATION:

- **ADDED A COLUMN TO CALCULATE THE ACTUAL TIME DURATION IN MINUTES USING THE FOLLOWING FORMULA:**
- **POWERQUERY**
- **COPYEDIT**

```
Duration.TotalMinutes(
    if [End Time] >= [Start Time]
    then [End Time] - [Start Time]
    else [End Time] - [Start Time] + #duration(1,0,0,0)
)
  'Line Productivity'[Wasted time] <> 0
)
```

THIS FORMULA CALCULATES THE DIFFERENCE BETWEEN "START TIME" AND "END TIME," ADDING A DAY IF THE TIME SPANS MIDNIGHT.

SPLITTING AM/PM:

SPLIT THE "START TIME" COLUMN INTO AM AND PM FOR BETTER TIME ANALYSIS.

CLASSIFYING TIME PERIODS:

CLASSIFIED "START TIME" INTO TIME PERIODS (MORNING, AFTERNOON, EVENING, NIGHT) USING THIS FORMULA:

```
let
    HourValue = Time.Hour([Start Time]),
    Period =
        if HourValue >= 0 and HourValue < 6 then "Night"
        else if HourValue >= 6 and HourValue < 12 then "Morning"
        else if HourValue >= 12 and HourValue < 18 then "Afternoon"
        else "Evening"
in
    Period
```

DATA TRANSFORMATION FOR LINE DOWNTIME

UNPIVOTING COLUMNS:
THE COLUMNS WERE UNPIVOTED TO CONVERT THEM INTO ROWS, WHICH ALLOWED FOR BETTER DATA STRUCTURE AND ANALYSIS. THIS STEP NORMALIZED THE DATA TO PROVIDE A MORE CONSISTENT FORMAT.
MERGING QUERIES:
A MERGE OPERATION WAS PERFORMED WITH THE "DOWNTIMEADDED" TABLE TO RETRIEVE THE DESCRIPTION COLUMN. THIS WAS DONE TO ENRICH THE "LINE DOWNTIME" TABLE WITH ADDITIONAL CONTEXT RELATED TO EACH DOWNTIME EVENT.
ADDING CONDITIONAL COLUMN:
A CONDITIONAL COLUMN WAS CREATED TO CLASSIFY DOWNTIME EVENTS INTO THREE CATEGORIES BASED ON THE INVOLVED FACTORS:
PEOPLE-RELATED ISSUES (E.G., HUMAN ERRORS, OPERATOR ACTIONS)
MACHINE-RELATED ISSUES (E.G., MECHANICAL FAILURES, EQUIPMENT MALFUNCTIONS)
PROCESS-RELATED ISSUES (E.G., OPERATIONAL INEFFICIENCIES, PROCESS BOTTLENECKS)
THIS CLASSIFICATION HELPS IN SEGMENTING THE DOWNTIME EVENTS, MAKING IT EASIER TO IDENTIFY AND FOCUS ON SPECIFIC PROBLEM AREAS.
CATEGORIZING DOWNTIME EVENTS:
THE DOWNTIME EVENTS WERE FURTHER CATEGORIZED AND TAGGED ACCORDING TO THE SEVERITY AND IMPACT. THIS CLASSIFICATION AIDS IN IDENTIFYING PATTERNS AND PRIORITIZING ISSUES THAT NEED IMMEDIATE ATTENTION.
2. OUTCOME:
THE DATA IS NOW ORGANIZED IN A MORE STRUCTURED AND DETAILED FORMAT, MAKING IT EASIER TO ANALYZE DOWNTIME EVENTS. THE TABLE INCLUDES ENRICHED INFORMATION FROM THE "DOWNTIMEADDED" TABLE, AND THE CATEGORIZATION ALLOWS FOR A CLEARER UNDERSTANDING OF WHERE IMPROVEMENTS CAN BE MADE TO MINIMIZE DOWNTIME AND ENHANCE OPERATIONAL EFFICIENCY.

DATA TRANSFORMATION FOR PRODUCTS TABLE

STEPS TAKEN:

REMOVING NULL VALUES:

NULL VALUES WERE REMOVED FROM THE PRODUCTS TABLE TO ENSURE THAT ONLY VALID AND COMPLETE RECORDS REMAIN FOR ANALYSIS. THIS HELPS IN ENSURING DATA INTEGRITY AND PREVENTING ANY INCONSISTENCIES DURING THE ANALYSIS.

EXTRACTING DATA FROM LINE PRODUCTIVITY:

DATA FROM THE LINE PRODUCTIVITY TABLE WAS EXTRACTED AND FILTERED. THIS STEP ALLOWED ME TO FOCUS ON THE RELEVANT PRODUCTS LINKED TO PRODUCTIVITY MEASURES. THE RELEVANT DATA WAS THEN STORED SEPARATELY IN A NEW TABLE TO FACILITATE EASIER TRACKING AND ANALYSIS.

CREATING A SEPARATE TABLE:

A SEPARATE TABLE WAS CREATED TO ISOLATE AND MANAGE PRODUCT-RELATED DATA INDEPENDENTLY. THIS STEP ENSURES THAT PRODUCT INFORMATION IS ORGANIZED AND CAN BE ANALYZED WITHOUT INTERFERENCE FROM OTHER OPERATIONAL DATA IN THE LINE PRODUCTIVITY TABLE.

2. OUTCOME:

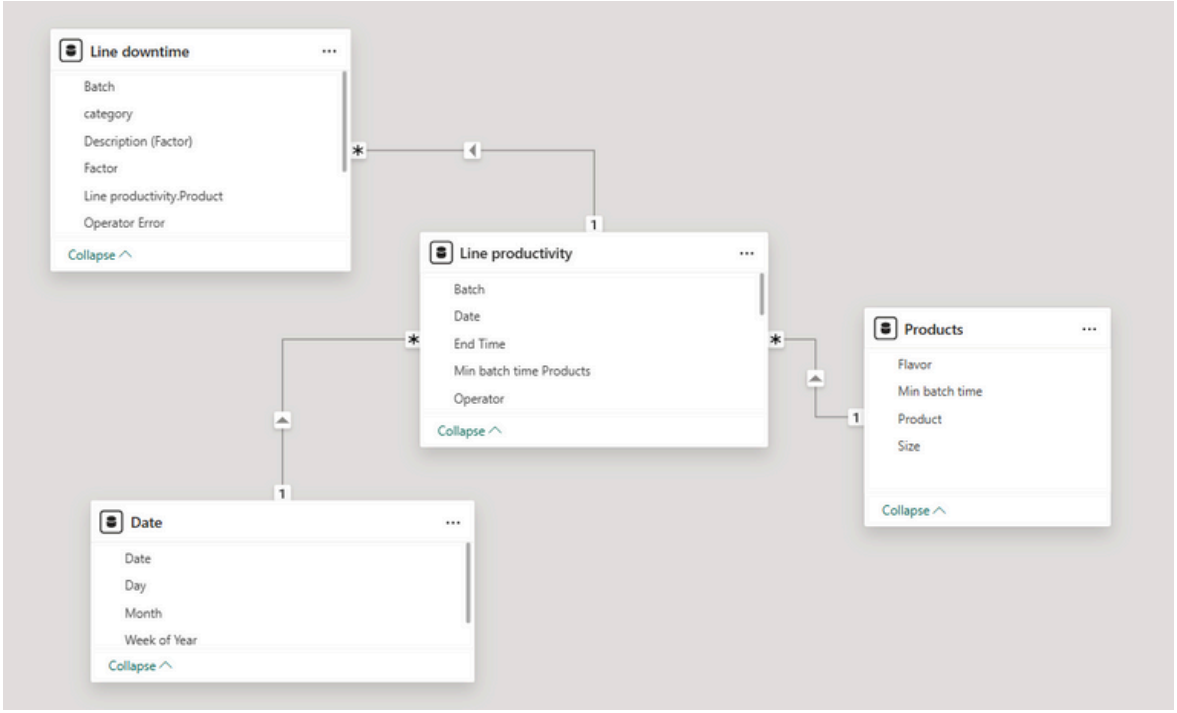
THE PRODUCTS TABLE IS NOW CLEANED AND ORGANIZED, WITH ALL NULL VALUES REMOVED. DATA FROM THE LINE PRODUCTIVITY TABLE HAS BEEN SUCCESSFULLY EXTRACTED AND SEPARATED FOR MORE EFFICIENT ANALYSIS AND INSIGHTS.

CHAPTER (THREE)

DATA MODELING

OBJECTIVES:

- DEFINE THE MODEL'S OBJECTIVE:
- IDENTIFY WHETHER THE GOAL IS PREDICTION (E.G., PREDICTING PRODUCTIVITY OR DOWNTIMES) OR CLASSIFICATION (E.G., CATEGORIZING DOWNTIMES INTO DIFFERENT TYPES).
- SELECT THE APPROPRIATE MODEL TYPE:
- CHOOSE THE MOST SUITABLE MODEL BASED ON THE TYPE OF DATA AND THE DESIRED OUTCOME, WHETHER IT'S A MACHINE LEARNING MODEL (E.G., REGRESSION, DECISION TREES) OR A STATISTICAL MODEL.
- PREPARE DATA FOR MODELING:
- ENSURE THE DATA IS ORGANIZED AND READY FOR TRAINING BY SPLITTING IT INTO TRAINING AND TEST SETS, AND MAKING ANY NECESSARY ADJUSTMENTS OR TRANSFORMATIONS.
- TRAIN THE MODEL:
- TRAIN THE MODEL USING THE TRAINING DATASET AND FINE-TUNE PARAMETERS TO ACHIEVE OPTIMAL PERFORMANCE.



1. FACT AND DIMENSION TABLES

FACT TABLE

- LINE PRODUCTIVITY:

THIS IS THE CENTRAL FACT TABLE THAT STORES INFORMATION ABOUT PRODUCTION BATCHES. EACH ROW REPRESENTS A PRODUCTION EVENT.

KEY COLUMNS:

- BATCH
- DATE
- END TIME
- MIN BATCH TIME PRODUCTS
- OPERATOR

DIMENSION TABLES

- LINE DOWNTIME:

DESCRIBES REASONS FOR PRODUCTION LINE DOWNTIMES RELATED TO SPECIFIC BATCHES.

KEY COLUMNS:

- BATCH
- CATEGORY
- DESCRIPTION (FACTOR)
- FACTOR
- LINE PRODUCTIVITY.PRODUCT
- OPERATOR ERROR

- PRODUCTS:
CONTAINS PRODUCT DETAILS.
KEY COLUMNS:
- PRODUCT
- FLAVOR
- SIZE
- MIN BATCH TIME

- DATE:
PROVIDES TIME-BASED INFORMATION.
KEY COLUMNS:
- DATE
- DAY
- MONTH
- WEEK OF YEAR

RELATIONSHIPS BETWEEN TABLES

Primary Table	Related Table	Relationship Type	Key	Explanation
Line productivity	Line downtime	One-to-Many	Batch	Each production batch
Line productivity	Products	Many-to-One	Product	Each batch is for one
Line productivity	Date	Many-to-One	Date	Each batch occurs on

CHAPTER (FOUR)

DAX

OBJECTIVES:

- BY THE END OF THIS CHAPTER, THE READER SHOULD BE ABLE TO:
- UNDERSTAND THE CONCEPT OF DAX
- EXPLAIN WHAT DAX (DATA ANALYSIS EXPRESSIONS) IS, ITS PURPOSE, AND WHERE IT IS USED (POWER BI, POWER PIVOT, ANALYSIS SERVICES).
- RECOGNIZE THE BASICS OF DAX SYNTAX
- UNDERSTAND THE STRUCTURE OF DAX FORMULAS AND DIFFERENT CATEGORIES OF FUNCTIONS (CALCULATION, FILTERING, TIME INTELLIGENCE, TEXT, STATISTICAL FUNCTIONS).
- WRITE SIMPLE AND ADVANCED DAX FORMULAS
- CREATE MEASURES AND CALCULATED COLUMNS TO PERFORM ESSENTIAL CALCULATIONS.
- UNDERSTAND ROW CONTEXT AND FILTER CONTEXT
- DISTINGUISH BETWEEN ROW CONTEXT AND FILTER CONTEXT AND HOW THEY AFFECT CALCULATION RESULTS.
- APPLY TIME INTELLIGENCE FUNCTIONS

THIS CODE IS USED TO CALCULATE THE PERCENTAGE OF PAYMENTS THAT WERE PROCESSED WITHOUT ISSUES AND THE PERCENTAGE OF PAYMENTS THAT ENCOUNTERED PROBLEMS.

```
1- Issues % = [With Issues]/[Nu.Batches]*100

2- No Issues % = [No Issues]/[Nu.Batches]*100
```

```
Factor Count = COUNTROWS
(DISTINCT('Line downtime'[Description (Factor)]))
```

CALCULATES THE ACTUAL NUMBER OF ISSUES THAT OCCURRED.

CALCULATES THE ERROR RATE BY DIVIDING THE WASTED TIME BY THE ACTUAL TIME.

```
reat erorr =
[Total_Time_H]/[total_time hou] *100
```

```
total_time hou = SUM('Line
productivity'[Total Min (Run
Time)])/60
```

A MEASURE THAT CALCULATES THE TOTAL TIME DURING WHICH ALL THE MACHINES OPERATED.

A MEASURE THAT CALCULATES THE NUMBER OF HOURS WASTED.

```
Total_Time_H = sum('Line
productivity'[Wasted time])/60
```

```
real for Charlie = [Total Run Time for
Charlie]-[Wasted Time for Charlie]
```

THE ACTUAL TIME WORKED BY CHARLIE

THE ACTUAL TIME WORKED BY DEE

```
real for Dee = [Total Run Time for
Dee]-[Wasted Time for Dee]
```

```
real for Dennis = [Total Run Time for
Dennis]-[Wasted Time for Dennis]
```

THE ACTUAL TIME WORKED BY DENNIS

THE ACTUAL TIME WORKED BY MAC

```
real for Mac = [Total Run Time for
Mac]-[Wasted Time for Mac]
```

```
Total Run Time for Mac =
CALCULATE(
    SUM('Line productivity'[Total Min
(Run Time)])/60,
    'Line productivity'[Operator] =
"Mac"
)
```

MAC'S AVERAGE WASTED TIME.

CHARLIE'S AVERAGE WASTED TIME.

```
Total Run Time for Charlie =
CALCULATE(
    SUM('Line productivity'[Total Min
(Run Time)])/60 ,
    'Line productivity'[Operator] =
"Charlie"
)
```

```
Total Run Time for Dee =
CALCULATE(
    SUM('Line productivity'[Total Min
(Run Time)])/60,
    'Line productivity'[Operator] =
"Dee"
)
```

DEE'S AVERAGE WASTED TIME.

DENNIS'S AVERAGE WASTED TIME.

```
Total Run Time for Dennis =
CALCULATE(
    SUM('Line productivity'[Total Min
(Run Time)])/60,
    'Line productivity'[Operator] =
"Dennis"
)
```

CHAPTER (FIVE)

ANALYSIS & INSIGHT

OBJECTIVES:

- IDENTIFY PATTERNS AND TRENDS
- DISCOVER CONSISTENT BEHAVIORS OR CHANGES OVER TIME (E.G., PEAK SALES PERIODS, DECLINING ENGAGEMENT).
- DETECT ISSUES OR BOTTLENECKS
- SPOT AREAS WHERE PERFORMANCE DROPS OR WHERE DELAYS OCCUR (E.G., HIGH DOWNTIME, LOW PRODUCTIVITY).
- PERFORM ROOT CAUSE ANALYSIS
- UNDERSTAND WHY A PROBLEM IS HAPPENING (E.G., WHY ARE SALES DECREASING? WHY IS CUSTOMER CHURN INCREASING?).
- GENERATE KEY PERFORMANCE INDICATORS (KPIS)
- DEFINE AND CALCULATE MEASURABLE METRICS TO TRACK PERFORMANCE (E.G., CONVERSION RATE, AVERAGE HANDLING TIME).
- IDENTIFY IMPROVEMENT OPPORTUNITIES
- HIGHLIGHT AREAS FOR OPTIMIZATION (E.G., STREAMLINE PROCESSES, IMPROVE TARGETING STRATEGIES).

WHAT IS THE TOTAL NUMBER OF BATCHES? AND WHAT IS THE PERCENTAGE OF BATCHES WITH NO ISSUES COMPARED TO THOSE WITH ISSUES?

- **TOTAL NUMBER OF BATCHES: 38**
- **PERCENTAGE OF BATCHES WITH NO ISSUES: 7.89%**
- **PERCENTAGE OF BATCHES WITH ISSUES: 92.11%**

HOW MANY BATCHES WERE PRODUCED EACH DAY?

- **THE HIGHEST NUMBER OF BATCHES WAS ON AUGUST 30 (AUG 30) WITH 12 BATCHES.**
- **FOLLOWED BY SEPTEMBER 2 (SEP 2) WITH 11 BATCHES.**
- **THEN AUGUST 31 (AUG 31) AND AUGUST 29 (AUG 29) WITH 7 BATCHES EACH.**
- **LASTLY, SEPTEMBER 3 (SEP 3) HAD ONLY 1 BATCH.**

HOW MANY BATCHES WERE PRODUCED FOR EACH PRODUCT SIZE?

- **33 BATCHES WERE PRODUCED FOR THE 600 ML SIZE**
- **5 BATCHES WERE PRODUCED FOR THE 2000 ML SIZE**

WHAT IS THE NUMBER OF ACTUAL ISSUES RECORDED?
A TOTAL OF 11 ACTUAL ISSUES WERE RECORDED.

WHAT IS THE RANKING OF THE OPERATORS BASED ON THE NUMBER OF BATCHES THEY HANDLED?

- **CHARLIE AND DEE RANKED FIRST WITH 11 BATCHES EACH.**
- **THEY ARE FOLLOWED BY DENNIS AND MAC, EACH WITH 8 BATCHES.**

HOW MANY BATCHES WERE PRODUCED FOR EACH OF THE FIVE BEVERAGE TYPES?

- **COLA: 20 BATCHES**
- **ROOT BEER: 7 BATCHES**
- **LIME-LEMON: 6 BATCHES**
- **DIET COLA: 4 BATCHES**
- **ORANGE: 1 BATCH**

WHICH PRODUCT HAD THE MOST ISSUES?

- **COLA HAD THE HIGHEST NUMBER OF ISSUES, WITH 24 PROBLEMS RECORDED.**
- **FOLLOWED BY 2L COLA WITH 11 PROBLEMS, THEN ROOT BEER (RB) WITH 11 PROBLEMS.**
- **AFTER THAT, LEMON-LIME (LE) HAD 8 PROBLEMS, FOLLOWED BY DIET COLA (DC) WITH 5 PROBLEMS, AND FINALLY ORANGE (OR) WITH 1 PROBLEM.**

WHICH PRODUCT HAD THE MOST ISSUES?

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KEY PRODUCTION INSIGHTS FOR OPERATOR: CHARLIE:
TOTAL REAL TIME: 19.30 HOURS
TOTAL WASTING TIME: 6.40 HOURS
WASTING REPRESENTS APPROXIMATELY 33% OF THE TOTAL WORKING TIME.
1. WASTING TIME BY DAY
WASTING TIME WAS RECORDED ACROSS 3 DAYS:
AUGUST 29: ~0.7 HOURS
AUGUST 30: ~2.3 HOURS
SEPTEMBER 2: ~3.3 HOURS
NOTE: THERE IS A CLEAR INCREASE IN DAILY WASTE, WHICH MAY INDICATE A WORSENING ISSUE IN THE PRODUCTION LINE OR A LACK OF EARLY INTERVENTION.
2. WASTING TIME BY CATEGORY (DESCRIPTION)
HUMAN ERROR: ~190 MINUTES (~3.17 HOURS)
MACHINE FAILURE: ~120 MINUTES (~2.0 HOURS)
PROCESS ISSUE: ~90 MINUTES (~1.5 HOURS)
OBSERVATION:
HUMAN ERROR IS THE BIGGEST CONTRIBUTOR TO WASTE. THIS COULD REQUIRE FOCUSED TRAINING OR AWARENESS FOR OPERATORS.
3. WASTING TIME BY SHIFT (MORNING VS NIGHT)
MORNING SHIFT: ~3.9 HOURS
NIGHT SHIFT: ~2.1 HOURS
OBSERVATION:
MORNING SHIFTS HAVE HIGHER WASTE, POSSIBLY DUE TO WORKLOAD PRESSURE OR LACK OF PROPER PREPARATION AT SHIFT START.
4. WASTING TIME BY PRODUCT
CO-2L: ~3.1 HOURS (HIGHEST)
CO-600: ~2.6 HOURS
LE-600: ~0.6 HOURS (LOWEST)
OBSERVATION:
CO-2L IS THE MOST WASTE-INTENSIVE PRODUCT. A REVIEW OF ITS PRODUCTION PROCESS OR RELATED MACHINERY IS RECOMMENDED.

KEY PRODUCTION INSIGHTS FOR OPERATOR: DEE:

- **TOTAL REAL TIME: 17.17 HOURS**
- **TOTAL WASTING TIME: 6.17 HOURS**
- **WASTING RATIO: AROUND 36% OF THE TOTAL TIME**

1. WASTING TIME BY DAY

- **AUGUST 30: ~2.3 HOURS**
- **AUGUST 31: ~0.9 HOURS**
- **SEPTEMBER 2: ~3.0 HOURS**

OBSERVATION: WASTE INCREASED AGAIN ON SEPTEMBER 2 AFTER A DIP ON AUGUST 31, INDICATING INCONSISTENT PERFORMANCE OR RECURRING ISSUES.

2. WASTING TIME BY DESCRIPTION (CATEGORY)

- **HUMAN ERROR: ~150 MINUTES (~2.5 HOURS)**
- **PROCESS ISSUE: ~140 MINUTES (~2.3 HOURS)**
- **MACHINE FAILURE: ~80 MINUTES (~1.3 HOURS)**

OBSERVATION:

HUMAN ERRORS REMAIN THE TOP REASON FOR WASTE, FOLLOWED CLOSELY BY PROCESS-RELATED PROBLEMS. MACHINES ARE THE LEAST CAUSE IN THIS CASE.

3. WASTING TIME BY SHIFT (PERIODS)

- **NIGHT SHIFT: ~3.7 HOURS**
- **MORNING SHIFT: ~2.4 HOURS**

OBSERVATION:

NIGHT SHIFTS SHOW MORE WASTE THAN MORNING ONES. THIS COULD BE DUE TO FATIGUE, LESS SUPERVISION, OR OTHER OPERATIONAL CHALLENGES.

4. WASTING TIME BY PRODUCT

- **CO-600: ~3.2 HOURS**
- **RB-600: ~2.8 HOURS**
- **DC-600: ~0.3 HOURS**

OBSERVATION:

CO-600 IS THE MOST WASTE-ASSOCIATED PRODUCT, SO ITS PROCESS FLOW OR MACHINE SETUP MAY NEED FURTHER REVIEW.

SUMMARY RECOMMENDATIONS FOR DEE

- **INVESTIGATE HUMAN ERRORS WITH DETAILED ANALYSIS TO REDUCE REPEAT MISTAKES.**
- **RECHECK THE WORKFLOW OR STANDARD PROCEDURES RELATED TO CO-600 AND RB-600.**
- **IMPROVE SUPPORT AND MONITORING DURING NIGHT SHIFTS.**
- **CONSIDER BENCHMARKING DEE’S PERFORMANCE WITH OTHER OPERATORS FOR IMPROVEMENT AREAS.**