Product Flow Optimization

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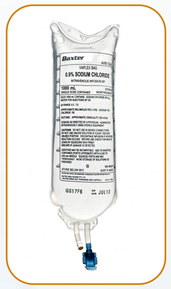
Company Description

Baxter International is the largest IV bag manufacturer in the world. They operate in 6 global business segments:

- Renal Care
- Medication Delivery
- Pharmaceuticals
- Clinical Nutrition
- Advanced Surgery
- Acute Therapies space.

Baxter Manufacturing Plant located in North Cove, NC



- Key Products: 250ml - 6L bags
- Over 1 million units daily
- Over **24 billion** units produced since 1972

Filling
- **Loader**
- **Printer**

→ **Sterilization** →

Packaging
- **Unloader**

Problem Description

Demands: Inefficiencies in the process result in an inability to meet their operational plan.

Cooling: Seasonal downtime at packing due to inefficient cooling process

Data Collection: Due to inconsistent and inefficient data collection, pinpointing the root problems for downtime is difficult

We assisted Baxter in identifying inefficiencies within the production process which included:
- Tracking downtime causes
- Determining which areas had the largest amount of downtime

Our goal was to help Baxter reach its goal of a 10% increase in Overall Equipment Effectiveness (OEE) by May.

Objectives

Identify at least **5 areas** where the greatest downtime originates in filling and packing lines.

Determine the top **3 causes** of downtime for each area.

Suggest improvements for **at least 1 top issue** per machine (unloader, loader, and printer.

Cooling Solution Recommendation

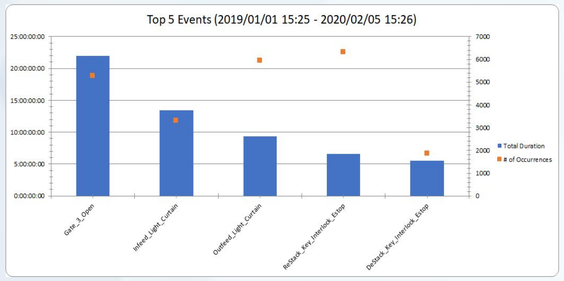
Attach portable/stationary fan to the side of the truck

- Benefits:
  - Does not change facility layout
  - Low cost solution
  - Does not take up space in facility
  - Faster cooling time, increased throughput
- Cons:
  - Increased process time due to manual handling of fans (only for portable fan)

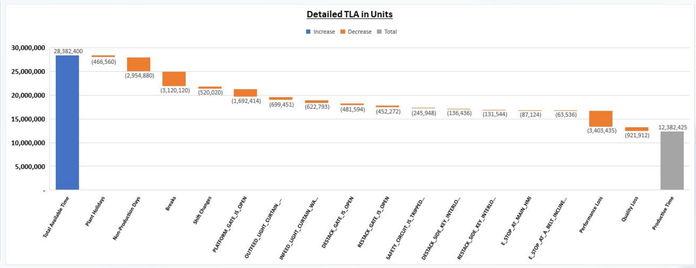
Implementation Plan

1. Obtain Excel files from the client
2. Cross Reference Data sets
3. Determine possible underlying causes of downtime
4. Calculate and analyze Overall Equipment Effectiveness
5. Create Loss Analysis to facilitate further analysis
6. Create Regression Model to analyze impact of top reasons of downtime on IV bag production

Data Analysis



The above figure shows the **total duration and number of occurrences** for the Loader in fill lines. The top 5 reasons for downtime are mentioned above. This will be repeated for the reloader and printer.



The figure above displays how the availability, performance loss, and quality loss impact the production of bags. By observing the graph, it can be shown that the performance loss is shown to be have the greatest impact, which is the **loss of 3,403,435 bags per year.**

Deliverables

```
                                                Estimate Std. Error
(Intercept)                                   35137.2742  5938.4113
BARCODE_FOIL_1_PE_BROKEN_FOIL                    -9.3946     3.3248
BARCODE_FOIL_ADVANCE_ENCODER_BROKEN_FOIL_DETECT   8.8794     3.0634
SAFETY_CIRCUIT_IS_TRIPPED_RESET_TO_CONTINUE       4.7338     1.8406
UNLOAD_STATION_VACUUM_CONFIRM_FAILED              9.0938     1.6251
PRINT_HEAD_1_BROKEN_FOIL_PROX                     1.1976     0.7038
OPERATOR_EXCEEDED_LOAD_TIME                      -0.7257     0.3074
                                                t value Pr(>|t|)
(Intercept)                                       5.917 1.04e-08 ***
BARCODE_FOIL_1_PE_BROKEN_FOIL                    -2.826  0.00509 **
BARCODE_FOIL_ADVANCE_ENCODER_BROKEN_FOIL_DETECT   2.899  0.00407 **
SAFETY_CIRCUIT_IS_TRIPPED_RESET_TO_CONTINUE       2.572  0.01068 *
UNLOAD_STATION_VACUUM_CONFIRM_FAILED              5.596 5.62e-08 ***
PRINT_HEAD_1_BROKEN_FOIL_PROX                     1.702  0.09000 .
OPERATOR_EXCEEDED_LOAD_TIME                      -2.361  0.01898 *
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```

		# of occurances (tally marks)	Downtime (min.)
Reason	Cause	Ex: IIII	30, 40, 32, etc.
Platform Gate Open	1. Jammed at toggle		
	2. Messed up index/offset		
	3. Shuttlework		
	4. Bags overlapped		
Outfeed light curtain tripped	1. Trucks are uneven		
	2. Someone walked too close to sensor		

Due to the lack of consistency from the data received, we developed a more concise document (pictured above) to record reasons of downtime that can be used to identify areas of focus.

Loss Analysis

This is a **"Loss Analysis"** of our client's downtime throughout the process and is based on practices used before our analysis.

		Availability	Performance Efficiency	Rate of Quality Products	OEE
Fill Line 4 and Pack Line 5	Loader	0.8542	0.6061	0.97	50.22%
	Printer	0.8542	0.4522	0.97	37.47%
	Unloader	0.8542	0.4982	0.97	41.28%
Fill Line 6 and Pack Line 12	Loader	0.8542	0.5923	0.97	49.08%
	Printer	0.8542	0.4164	0.97	34.50%
	Unloader	0.8542	0.4953	0.97	41.04%

From analyzing the results from the OEE calculations above, the **performance efficiency** column has the room for most improvement across the lines. That column compares the cycle time of the machine to the number of IV bags being produced.

Conclusion

Printer

By analyzing all the findings, we concluded that the printer had the largest impact on production due to these events:
1. **Broken Barcode Foil**
   a. **Rolling foil with a nik in it**
   b. **Misalignment causes break and tears**
   c. **Plow has a burr on it**
      i. **Small dents/tears**

Future Recommendations:
1. Implement regular maintenance team for machinery (rolling foil, plow)
2. Look for more durable foil
3. Install a deburring machine

Loader and Unloader

By analyzing all the findings, we concluded that the loader and unloader had the largest impact on production due to these events:
1. **Truck Problems**
   a. **Misaligned trucks, Missing Wheels, Warped Trays**
      i. **Loader: 370,000 bags lost annually**
      ii. **Unloader: 149,000 bags lost annually**
2. **Accumulation of minor breakdowns**

Future Recommendations:
1. Incorporate preventive maintenance for truck fleets
2. Look into truck replacements that can withstand heat and use.
3. Study misalignment issues to determine whether the cause lies with the worker or robotic arm.

Moving Forward

Since the critical issues within the process revolve around performance errors, we believe it would be beneficial for Baxter to:
- Implement suggestions mentioned in previous slides.
- Use our data collection tool to further investigate causes behind downtime reasons listed by machines.
  - Tackle the ones that are most prevalent in the data collection tool.