Overall Equipment Efficiency
Tasteful Selections Packaging Operation

W200 Spring 2020

Project 2

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Industry and Organization

Innovations Needed!

Overall Question

The VP of Plant Operations at Tasteful Selections requested the need to understand the Overall Equipment Effectiveness (OEE) for the entire Pack Room.

OEE = Performance x Quality x Availability

Performance - actual bags per minute/theoretical bags per minute

Quality - number of good bags/total bags

Availability - Packing Line uptime/total scheduled shift time

This KPI provides the plant with the understanding of its efficiency and what it needs to do to improve.

Analysis Steps

Data Cleaning/Formatting

1. Converted date from string to datetime object.
2. Created day of the week and week of the year columns.
3. Type cast Out Count(number of bags) from float to integer.
4. Dropped Packing Line 14 because it doesn't run consistently so very limited useful data.
5. Created packing line type of bagger and packline details to determine if there is a visual relationship in thruput.

date string to datetime function

```
# Change date to datetime.
def create_datetime_obj(date_string):
    date_string = date_string.split('-')
    day = date_string[0]
    month = date_string[1]
    year = date_string[2]
    date_time = month + '/' + day + '/' + year
    datetime_obj = datetime.strptime(date_time,'%b/%d/%y')
    return datetime_obj

# Check if function works
create_datetime_obj(df_all.date[0])
```

```
datetime.datetime(2020, 2, 25, 0, 0)
```

packline_type/packline_details

```
packline_type = {'Packing Line 01': 'mesh',
                 'Packing Line 02': 'mesh',
                 'Packing Line 03': 'mesh',
                 'Packing Line 04': 'vertical mesh',
                 'Packing Line 05': 'wicket mesh',
                 'Packing Line 06': 'mesh',
                 'Packing Line 07': 'poly',
                 'Packing Line 08': 'poly',
                 'Packing Line 09': 'poly',
                 'Packing Line 10': 'pouch',
                 'Packing Line 11': 'pouch',
                 'Packing Line 12': 'tray',
                 'Packing Line 13': 'bulk',
                 'Packing Line 14': 'steam pack mini'
                }
packline_details = {'Packing Line 01': 'single_mesh',
                    'Packing Line 02': 'double_mesh',
                    'Packing Line 03': 'single_mesh',
                    'Packing Line 04': 'N/A',
                    'Packing Line 05': 'N/A',
                    'Packing Line 06': 'double_mesh',
                    'Packing Line 07': 'triangle',
                    'Packing Line 08': 'triangle',
                    'Packing Line 09': 'matrix',
                    'Packing Line 10': 'N/A',
                    'Packing Line 11': 'N/A',
                    'Packing Line 12': 'N/A',
                    'Packing Line 13': 'N/A',
                    'Packing Line 14': 'N/A'
                   }

df_final.insert(5,'packline_type',df_final.location.map(packline_type))
df_final.insert(6,'packline_details',df_final.location.map(packline_details))
df_final.head()
```

Overall Pack Room OEE

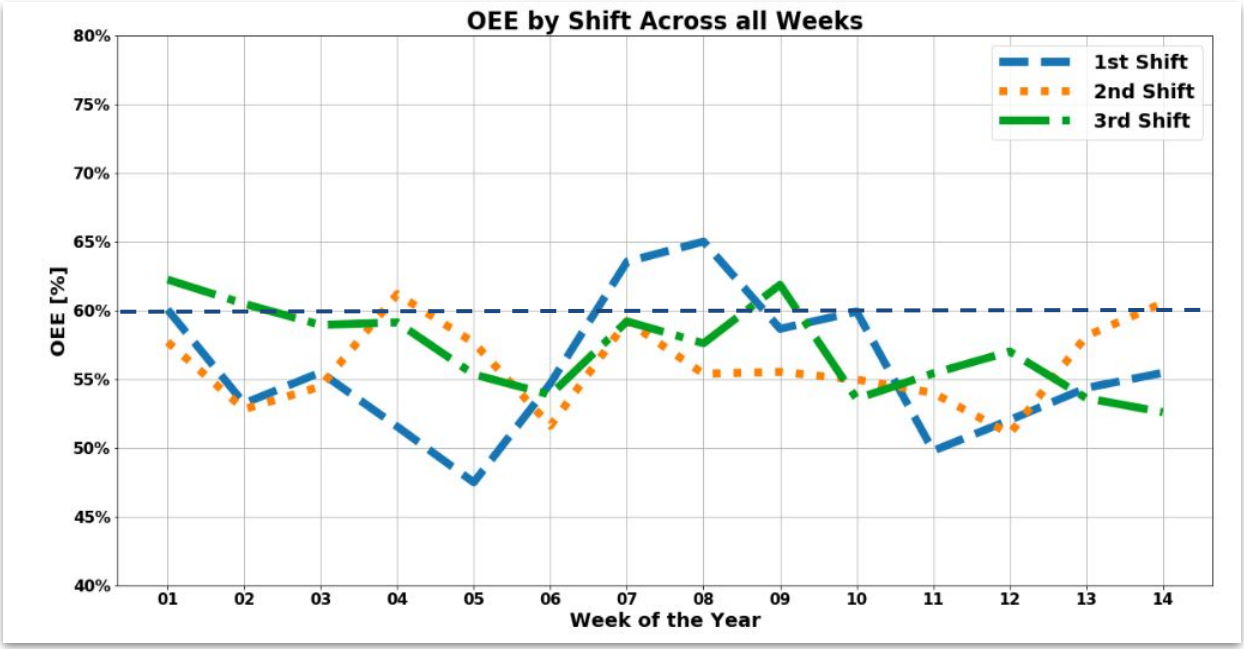

Figure 1: OEE Trends split by Shift

Data Shaping & Visualization

- Grouped data by week and shift.
- Calculated the average weekly OEE by Shift.

Pack Room Out Count

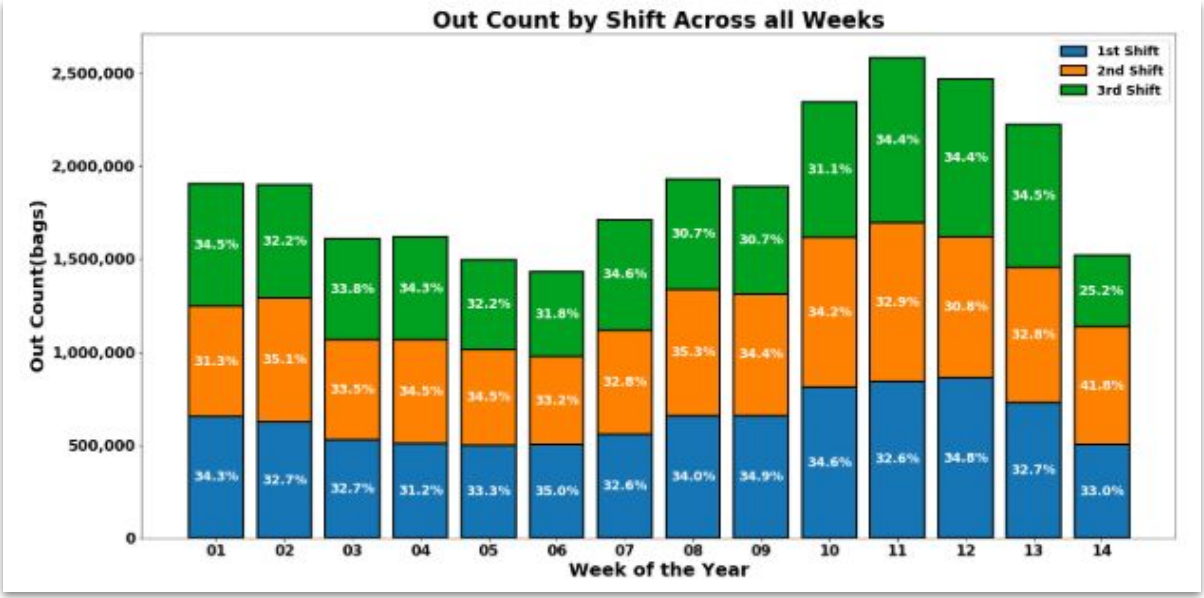

Figure 2: Split by Shift, All Packing Line Out Count

- Used a grouped dataframe to determine out counts per shift.
- Notice the spike in production during March.
- Evenly distributed out counts across all shifts.

Pack Room OEE and Out Count

Data Shaping & Visualization

- Grouped data by week and shift.
- Weekly OEE by Shift.
- Weekly Out Count by Shift

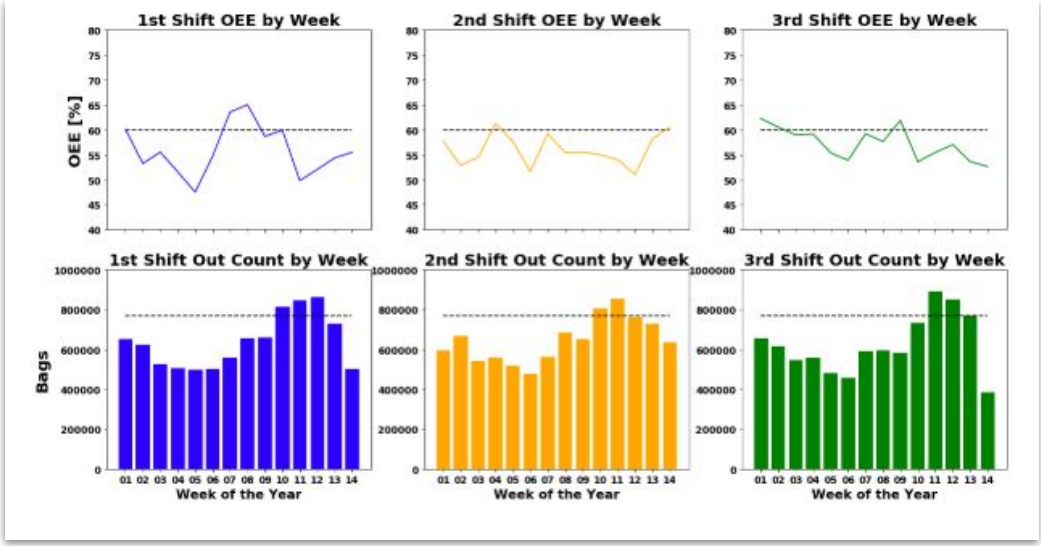

Figure 3: OEE and Out Counts Trends by Shift

Pack Line 07, 08, and 09 Analysis

- Packing line 07 and 08 have a larger throughput than Packing line 09.
  - The theoretical maximum packing limit per week for Packing line 07 and 08 is 460,800 bags.
  - Packing line 09 theoretical limit is 345,600 bags. Once the stay at home order was set in place you can see this in the data.

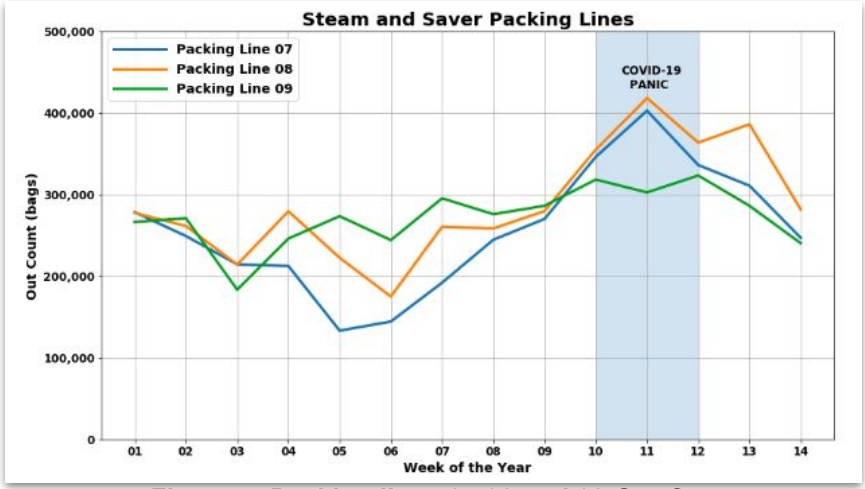

Figure 4: Packing lines 07,08 and 09 Out Count

During the busiest weeks of the year, Packing Line 07 and 08 had ~33% more throughput than Packing Line 09.

Pack Line 03 Analysis

- **Giro Bagger** underperforms greatly compared to the **C-Pack Mesh Bagger.**

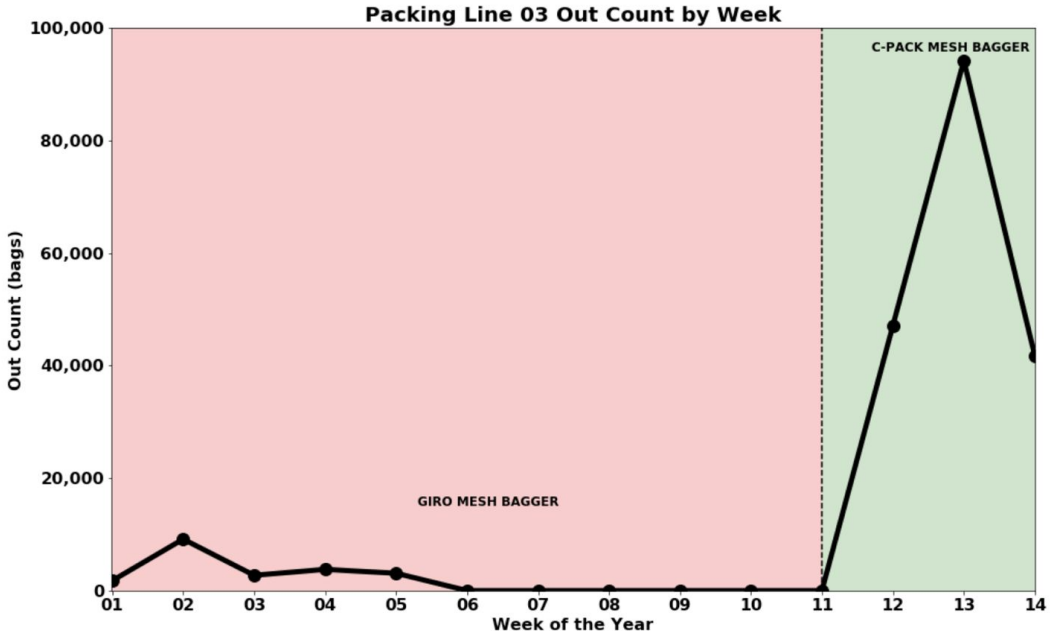

Figure 5

Pack Line OEE and Out Count Correlation

- Linear regression between Packing Line 07 and the normalized Out Count was performed split by Shift.
  - The Out Count was normalized to the maximum of the shift.

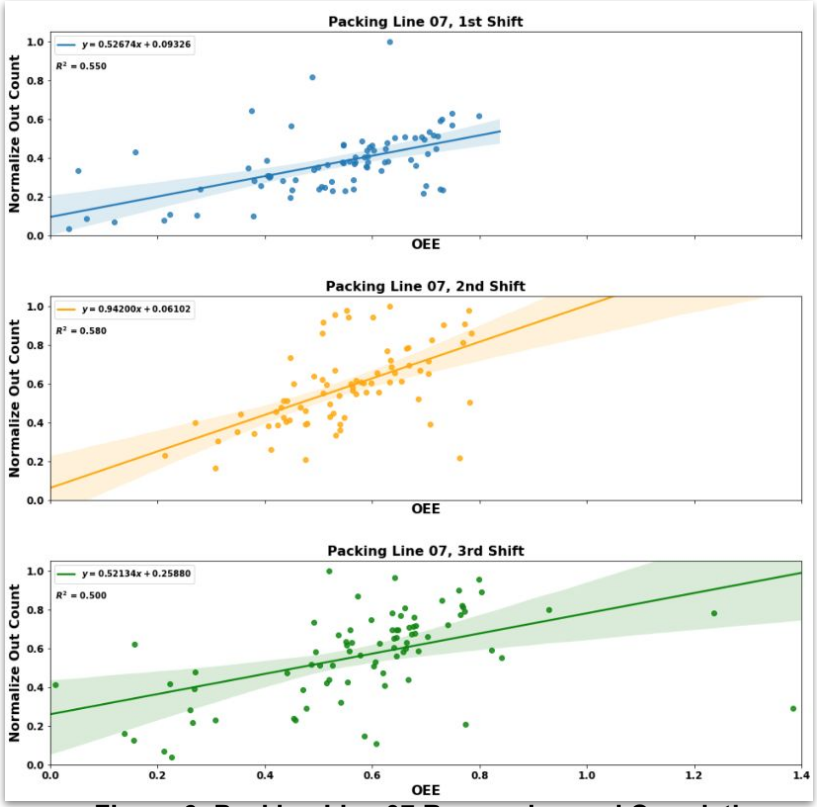

Figure 6: Packing Line 07 Regression and Correlation

Assumptions Made in Analysis

- Theoretical maximum limit
- Pack Line 02 and 06 out counts

Takeaways and Future Work

- Overall Pack Room OEE
- Overall Production
- Polybag Pack Line Performance
- COVID-19 panic buying impact on agriculture.
- Correlation between OEE and Out Count
- A more accurate method for measuring Pack Line performance.
- Real-time data stream and analysis.
- Predictive forecasting of demand and OEE.
- Optimization of OEE.