Aikeen Industries

Aikeen Industries is a leading manufacturer and seller of gourmet crips & nachos products.

It is looking at its operations wanting to sync all aspects of its business from production to forecasting.

Aikeen Industries' priority is to ensure a strong production, selling and forecasting business model to take the company to the phase 1 of their expansion plan.

Business Questions to solve:

1. Sales team performance by comparing Sales Forecast to Production Forecast.
2. Inefficiencies in forecast by comparing Actual Production to Production Forecast.
3. Accuracy of Forecast = [(Actual Production/Production Forecast) *100]
4. Identify products with high inaccuracies in forecasts based on historical data (2020 till date)
5. How many shortages of orders? (compare Sales Orders vs Finished Goods Inventory?)
6. Calculate Sell-through rate: Sell-through rate = (Units Consumed/Units Produced)
7. Identify items in Finished Goods Inventory for which we have no or low sales (consumed means sold).
8. Fill rate = [(*Total Units in inventory-Consumed Units)/Total Units in inventory]* 100
9. Predict the remaining 2022 forecast using Actual Production vs Production Forecast
10. Predict the 2022 sales team performance using Sales Forecast vs Production Forecast

*Total Units in inventory = Opening plus produced minus consumed

Load Data

In [1]:
```
#import libraries

import pandas as pd
import seaborn as sns
import numpy as np

import matplotlib
import matplotlib.pyplot as plt
import waterfall_chart
```

```
import seaborn as sns
```

In [2]:
```
# Load csv files

df_SO = pd.read_csv('C:/Users/k3ke/Aikeen Industries/Sales Order.csv')
df_Act_Prod = pd.read_csv('C:/Users/k3ke/Aikeen Industries/Actual Production.csv')
df_Fin_Inv = pd.read_csv('C:/Users/k3ke/Aikeen Industries/Finished Good Inventory.csv')
df_Machines = pd.read_csv('C:/Users/k3ke/Aikeen Industries/Machines.csv')
df_ProdSales_FX = pd.read_csv('C:/Users/k3ke/Aikeen Industries/Production & Sales Forecast.csv')
df_Products = pd.read_csv('C:/Users/k3ke/Aikeen Industries/Products.csv')
```

Data Preparation

- Detecting outliers
- Detecting unnecessary columns
- Detecting errors in finished goods inventory table

In [3]:
```
df_SO.head()
```

Out[3]:

	Product	Quantity	7-May-22	8-May-22	9-May-22	10-May-22	11-May-22	12-May-22	13-May-22	14-May-22	15-May-22	16-May-22	17-May-22	18-May-22	19-May-22	20-May-22
0	Product 1	141	0	0	0	0	0	0	36	0	0	0	0	0	0	0
1	Product 2	877	0	0	36	90	0	180	216	0	0	36	198	36	0	0
2	Product 3	1593	0	0	25	0	0	100	100	0	0	125	175	0	0	0
3	Product 4	463	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Product 5	2284	0	0	576	300	0	1320	1392	0	0	192	1296	288	0	0

In [4]:
```
df_Products.head()
```

Out[4]:

	Product	Product Type
0	Product 1	Cheddar & Sour
1	Product 2	Cheddar & Sour
2	Product 3	Cheddar & Sour
3	Product 4	Cheddar & Sour
4	Product 5	Cheddar & Sour

In [5]:
```
df_ProdSales_FX.head()
```

Out[5]:

	Date	Product	Forecast Type	Forecast Units	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	Unnamed: 10	Unnamed: 11	Unname
0	1/1/2020	Product 1	Production Forecast	1532	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
1	1/1/2020	Product 1	Sales Forecast	1532	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
2	2/1/2020	Product 1	Production Forecast	1908	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
3	2/1/2020	Product 1	Sales Forecast	1908	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
4	3/1/2020	Product 1	Production Forecast	1800	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na

In [6]:
```
df_Act_Prod.head()
```

Out[6]:

	Date	Machine	Product	Quantity	Shift
0	1/2/2020	F-12	Product 1	132	Shift#2
1	1/16/2020	F-12	Product 1	216	Shift#2
2	1/17/2020	F-12	Product 1	348	Shift#1
3	1/31/2020	F-12	Product 1	72	Shift#2

	Date	Machine	Product	Quantity	Shift
4	2/2/2020	F-12	Product 1	324	Shift#2

In [7]:
```
# Found the closing value on the first row is not correct

df_Fin_Inv.head()
```

Out[7]:

	Date	Product	Opening	Produced	Consumed	Closing
0	5/24/2022	Product 1	141	0	-12	141
1	5/24/2022	Product 2	949	0	-72	877
2	5/24/2022	Product 3	1486	182	-75	1593
3	5/24/2022	Product 4	463	0	0	463
4	5/24/2022	Product 5	2980	492	-1188	2284

In [8]:
```
df_Machines.head()
```

Out[8]:

	Machines	Machine Type
0	F-1	Forming
1	F-2	Forming
2	F-3	Forming
3	F-4	Forming
4	F-5	Forming

In [9]:
```
#Found negative values and unnecessary columns in this particular df

df_ProdSales_FX.head()
```

Out[9]:

	Date	Product	Forecast Type	Forecast Units	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	Unnamed: 10	Unnamed: 11	Unname
0	1/1/2020	Product 1	Production Forecast	1532	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
1	1/1/2020	Product 1	Sales Forecast	1532	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
2	2/1/2020	Product 1	Production Forecast	1908	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
3	2/1/2020	Product 1	Sales Forecast	1908	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na
4	3/1/2020	Product 1	Production Forecast	1800	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	Na

Data Cleaning

1. Dropping negative values/transforming outliers.
2. Dropping unnecessary columns from Production and Sales Forecast DataFrame.
3. Drop the "Closing" column in finished goods inventory DataFrame because the value is inaccurate.
4. Re-create new "Closing" column.
5. Drop the "Quantity" column in Sales Order DataFrame because inaccurate value, will be using the "Closing" column in finished goods inventory DataFrame.

In [10]:

```
# Cleaning Data (drop negative values and unnecessary columns in this particular df)

df_ProdSales_FX.drop(df_ProdSales_FX[df_ProdSales_FX['Forecast Units'] < 0].index, inplace = True)
df_ProdSales_FX.drop(df_ProdSales_FX.iloc[:, 4:], axis=1, inplace=True)
```

In [11]:

```
df_ProdSales_FX.head()
```

Out[11]:

	Date	Product	Forecast Type	Forecast Units
0	1/1/2020	Product 1	Production Forecast	1532
1	1/1/2020	Product 1	Sales Forecast	1532

	Date	Product	Forecast Type	Forecast Units
2	2/1/2020	Product 1	Production Forecast	1908
3	2/1/2020	Product 1	Sales Forecast	1908
4	3/1/2020	Product 1	Production Forecast	1800

In [12]:
```
# Re-check for negative values

df_ProdSales_FX.loc[df_ProdSales_FX['Forecast Units'] < 0]
```

Out[12]:

Date	Product	Forecast Type	Forecast Units

In [13]:
```
# Drop the "Closing" column in finished goods inventory DataFrame.

df_Fin_Inv.drop(['Closing'], axis=1)
```

Out[13]:

	Date	Product	Opening	Produced	Consumed
0	5/24/2022	Product 1	141	0	-12
1	5/24/2022	Product 2	949	0	-72
2	5/24/2022	Product 3	1486	182	-75
3	5/24/2022	Product 4	463	0	0
4	5/24/2022	Product 5	2980	492	-1188
...	...	...	...	...	...
171	5/24/2022	Product 203	1916	0	0
172	5/24/2022	Product 204	1184	0	0
173	5/24/2022	Product 205	793	0	0
174	5/24/2022	Product 206	78	0	-60
175	5/24/2022	Product 208	1	0	0

176 rows × 5 columns

In [14]:
```
# Re-create new "Closing" column.

df_Fin_Inv['Closing'] =  df_Fin_Inv[['Opening', 'Produced', 'Consumed']].sum(axis=1)
```

In [15]:
```
# Re-check the value in the new DataFrame

df_Fin_Inv.head()
```

Out[15]:

	Date	Product	Opening	Produced	Consumed	Closing
0	5/24/2022	Product 1	141	0	-12	129
1	5/24/2022	Product 2	949	0	-72	877
2	5/24/2022	Product 3	1486	182	-75	1593
3	5/24/2022	Product 4	463	0	0	463
4	5/24/2022	Product 5	2980	492	-1188	2284

In [16]:
```
# Drop the "Qty" column in Sales Order DataFrame.

df_SO2 = df_SO.drop(['Quantity'], axis=1)
```

In [17]:
```
# Summarize and create a new colum for total Sales Order

df_SO2['SO SUM'] = df_SO2.iloc[:,2:15].sum(axis=1)
```

In [18]:
```
df_SO2.head(10)
```

Out[18]:

	Product	7-May-22	8-May-22	9-May-22	10-May-22	11-May-22	12-May-22	13-May-22	14-May-22	15-May-22	16-May-22	17-May-22	18-May-22	19-May-22	20-May-22	SO SUM
0	Product 1	0	0	0	0	0	0	36	0	0	0	0	0	0	0	36
1	Product 2	0	0	36	90	0	180	216	0	0	36	198	36	0	0	792
2	Product 3	0	0	25	0	0	100	100	0	0	125	175	0	0	0	525

	Product	7-May-22	8-May-22	9-May-22	10-May-22	11-May-22	12-May-22	13-May-22	14-May-22	15-May-22	16-May-22	17-May-22	18-May-22	19-May-22	20-May-22	SO SUM
3	Product 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Product 5	0	0	576	300	0	1320	1392	0	0	192	1296	288	0	0	5364
5	Product 6	0	0	108	0	0	312	180	0	0	84	288	48	0	0	1020
6	Product 1791	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Product 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Product 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Product 10	0	0	0	480	0	0	0	0	0	0	0	0	0	0	480

Business Questions to solve:

1. What's the sales team performance based on Sales forecast to Production forecast.

In [19]:

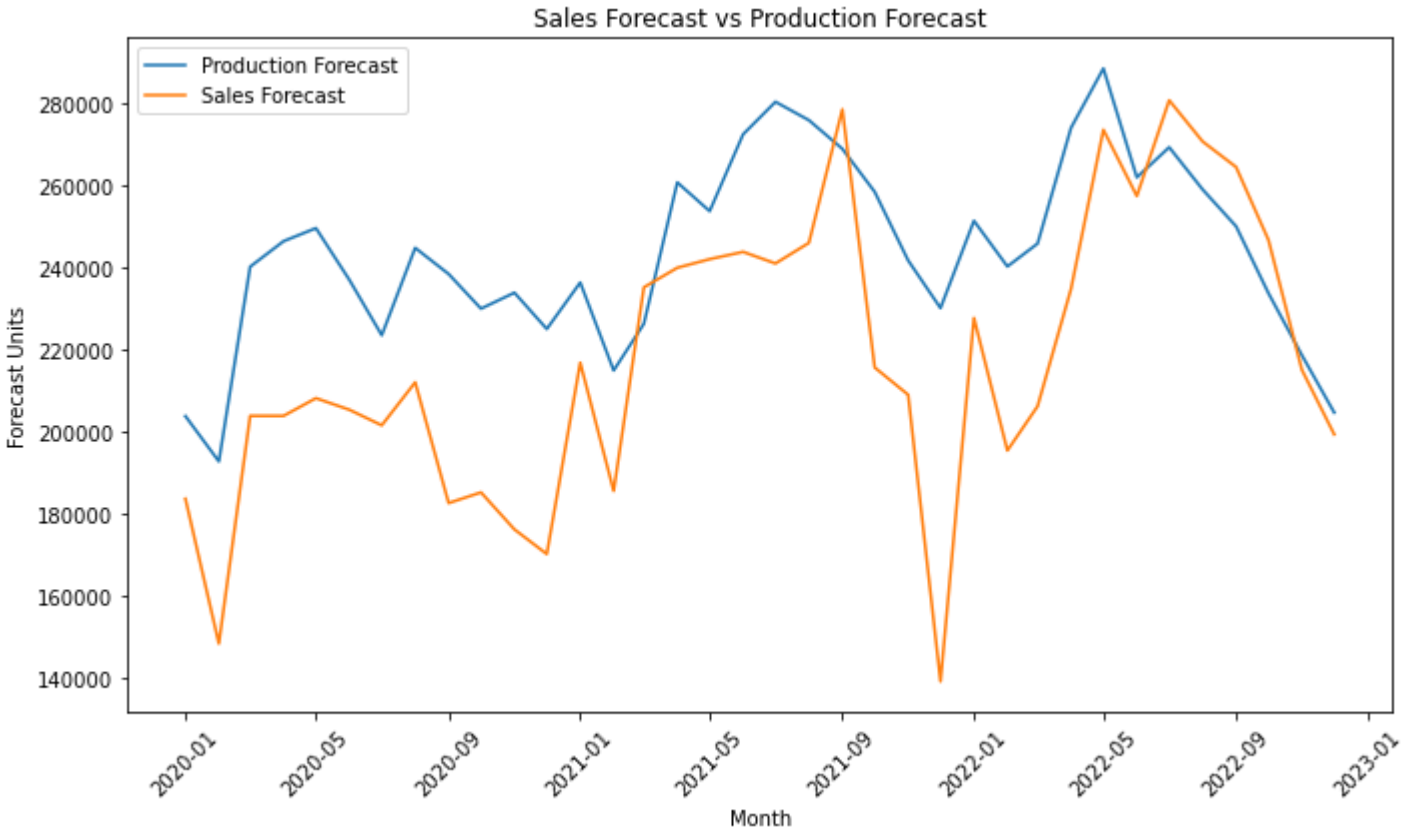
```
# Group and sum the forecast units for each Forecast Type
sum_df = df_ProdSales_FX.groupby(['Date', 'Forecast Type'])['Forecast Units'].sum().unstack()

sum_df.head()
```

Out[19]:

Forecast Type	Production Forecast	Sales Forecast
Date		
1/1/2020	203857	183707
1/1/2021	236438	216878
1/1/2022	251487	227792
10/1/2020	230063	185249
10/1/2021	258542	215713

In [20]:

```
# Convert the index to datetime format
sum_df.index = pd.to_datetime(sum_df.index)

# Sort the DataFrame by the index (dates)
sum_df.sort_index(inplace=True)

# Set the figure size to be wider (adjust the width and height as needed)
plt.figure(figsize=(10, 6))
plt.plot(sum_df['Production Forecast'], label='Production Forecast')
plt.plot(sum_df['Sales Forecast'], label='Sales Forecast')

plt.xlabel('Month')
plt.ylabel('Forecast Units')
plt.title('Sales Forecast vs Production Forecast')
plt.xticks(rotation=45)
plt.legend()
plt.tight_layout()
plt.show()
```



Business Questions to solve:

1. Inefficiencies in forecast by comparing Actual Production to Production Forecast.

In [21]:

```
# Create new Production Forecast dataframe (dropping the Sales Forecast)

ProdFX_df = df_ProdSales_FX[df_ProdSales_FX['Forecast Type'] == 'Production Forecast'][['Date', 'Forecast Units']]

# Reset the index so that it starts from 0 again
ProdFX_df1 = ProdFX_df.reset_index(drop=True)
ProdFX_df1.head()
```

Out[21]:

	Date	Forecast Units
0	1/1/2020	1532

	Date	Forecast Units
1	2/1/2020	1908
2	3/1/2020	1800
3	4/1/2020	1092
4	5/1/2020	12

In [22]:
```
# Create new Actual Production dataframe (dropping the Machine & Shift columns)

df_Act_Prod2 = df_Act_Prod[['Date','Quantity']]
df_Act_Prod3 = df_Act_Prod2.copy()
```

In [23]:
```
# Convert the 'Date' column to datetime type

df_Act_Prod3['Date'] = pd.to_datetime(df_Act_Prod3['Date'])
ProdFX_df1['Date'] = pd.to_datetime(ProdFX_df1['Date'])
```

In [24]:
```
# Group the ProdFX_df1 data by month and sum the Forecast Units

ProdFX_df1_monthly = ProdFX_df1.groupby(ProdFX_df1['Date'].dt.to_period('M')).sum()
ProdFX_df1_monthly.head()
```

Out[24]:

	Forecast Units
Date	
2020-01	203857
2020-02	192802
2020-03	240289
2020-04	246514
2020-05	249688

In [25]:
```
# Group the df_Act_Prod2 data by month and sum the Quantity
```

```
df_Act_Prod3_monthly = df_Act_Prod3.groupby(df_Act_Prod3['Date'].dt.to_period('M')).sum()
df_Act_Prod3_monthly.head()
```

Out[25]:

Date	Quantity
2020-01	109464
2020-02	104643
2020-03	105909
2020-04	73939
2020-05	92433

In [26]:

```
# Merge the DataFrames on the 'Date' column
merged_df = pd.merge(df_Act_Prod3_monthly, ProdFX_df1_monthly, on='Date', how='outer')

# Fill any missing values with 0
merged_df['Quantity'].fillna(0, inplace=True)
merged_df['Forecast Units'].fillna(0, inplace=True)
```

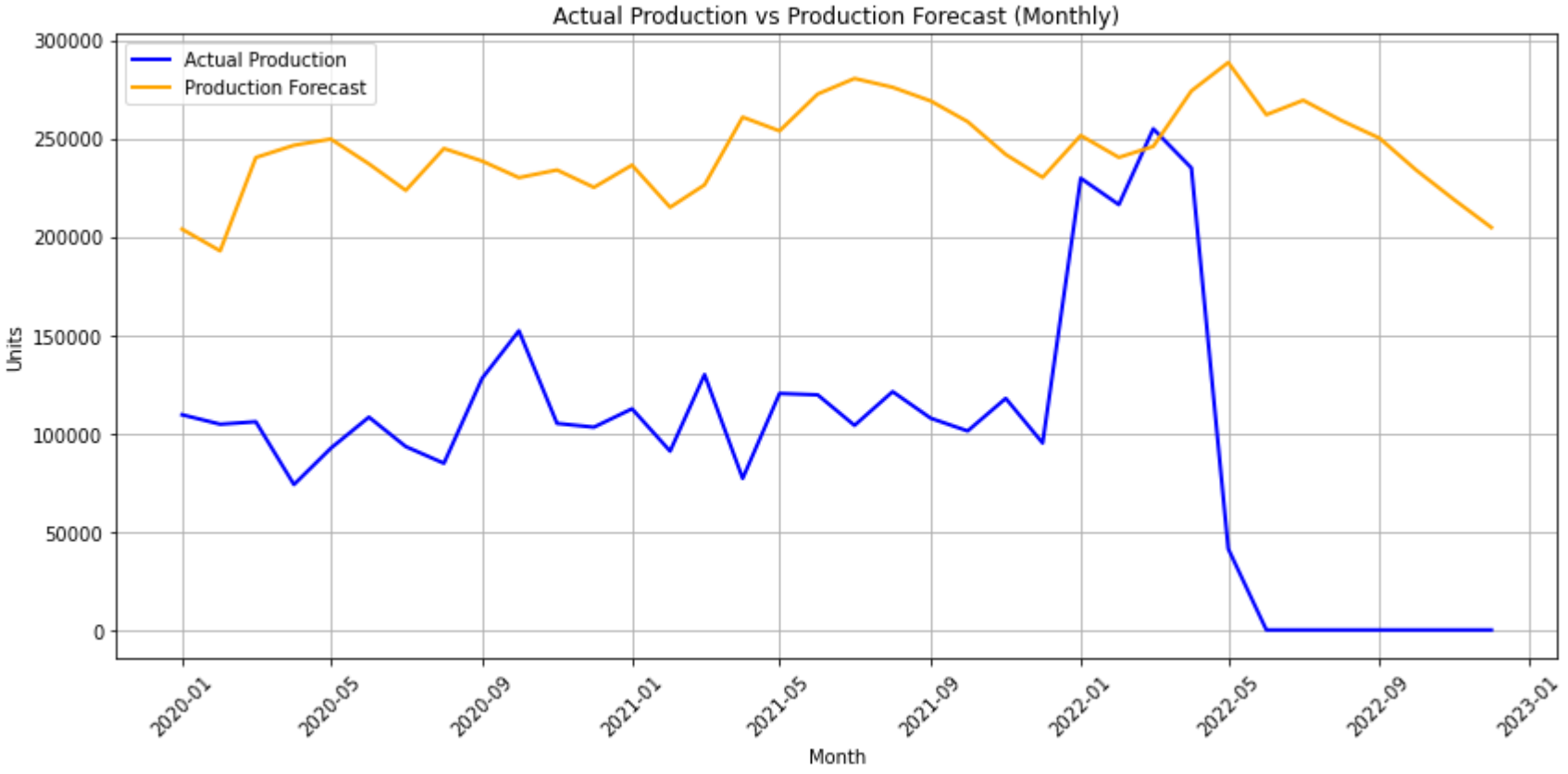
In [27]:

```
# Convert the 'Date' column back to datetime type for plotting
merged_df['Date'] = merged_df.index.to_timestamp()
```

In [28]:

```
# Plot the time series graph
plt.figure(figsize=(12, 6))

# Plot Quantity as a line graph
plt.plot(merged_df['Date'], merged_df['Quantity'], label='Actual Production', color='blue', linewidth=2)

# Plot Forecast Units as a line graph
plt.plot(merged_df['Date'], merged_df['Forecast Units'], label='Production Forecast', color='orange', linewidth=2)

# Set labels and title
plt.xlabel('Month')
plt.ylabel('Units')
plt.title('Actual Production vs Production Forecast (Monthly)')

# Add gridlines for better readability
```

```
plt.grid(True)

# Add legend
plt.legend()

# Rotate the x-axis labels for better readability (optional)
plt.xticks(rotation=45)

# Display the graph
plt.tight_layout()
plt.show()
```



Business Questions to solve:

1. Accuracy of Forecast = [(Actual Production/Production Forecast) *100]

In [29]:
```
# Create a copy of the original DataFrame
ProdFX_df4 = ProdFX_df.copy()

# Replace zero values in 'Forecast Units' column with a small non-zero value in the new DataFrame
ProdFX_df4['Forecast Units'] = ProdFX_df4['Forecast Units'].replace(0, 0.0001)
```

In [30]:
```
Acc_FX = (df_Act_Prod2['Quantity']/ProdFX_df4['Forecast Units'])/100

# Calculate the overall accuracy by taking the average of forecast_accuracy
Overall_accuracy = Acc_FX.mean()

# Convert the overall_accuracy to a percentage
accuracy_percentage = round(Overall_accuracy, 2)

print("Accuracy of Forecast:", accuracy_percentage, "%")
```

```
Accuracy of Forecast: 47.68 %
```

Business Questions to solve:

1. Identify products with high inaccuracies in forecasts based on historical data (2020 till date)

In [31]:
```
# Merge data frames (Actual Production with Product Type)

df_Act_Prod4 = df_Act_Prod.merge(df_Products, on='Product', how='left')
df_Act_Prod4.head()
```

Out[31]:

	Date	Machine	Product	Quantity	Shift	Product Type
0	1/2/2020	F-12	Product 1	132	Shift#2	Cheddar & Sour
1	1/16/2020	F-12	Product 1	216	Shift#2	Cheddar & Sour
2	1/17/2020	F-12	Product 1	348	Shift#1	Cheddar & Sour
3	1/31/2020	F-12	Product 1	72	Shift#2	Cheddar & Sour
4	2/2/2020	F-12	Product 1	324	Shift#2	Cheddar & Sour

In [32]:
```
# Merge data frames (Production Forecast with Product Type)

df_ProdSales_FX2 = df_ProdSales_FX.merge(df_Products, on='Product', how='left')
df_ProdSales_FX2.head()
```

Out[32]:

	Date	Product	Forecast Type	Forecast Units	Product Type
0	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour
1	1/1/2020	Product 1	Sales Forecast	1532	Cheddar & Sour
2	2/1/2020	Product 1	Production Forecast	1908	Cheddar & Sour
3	2/1/2020	Product 1	Sales Forecast	1908	Cheddar & Sour
4	3/1/2020	Product 1	Production Forecast	1800	Cheddar & Sour

In [33]:
```
# Drop rows with 'Sales Forecast' in the 'Forecast Type' column
df_ProdSales_FX2 = df_ProdSales_FX2.drop(df_ProdSales_FX2[df_ProdSales_FX2['Forecast Type'] == 'Sales Forecast'].index)
df_ProdSales_FX2.head()
```

Out[33]:

	Date	Product	Forecast Type	Forecast Units	Product Type
0	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour
2	2/1/2020	Product 1	Production Forecast	1908	Cheddar & Sour
4	3/1/2020	Product 1	Production Forecast	1800	Cheddar & Sour
6	4/1/2020	Product 1	Production Forecast	1092	Cheddar & Sour
8	5/1/2020	Product 1	Production Forecast	12	Cheddar & Sour

In [34]:
```
# Merge the two dataframes

df_5 = pd.merge(df_ProdSales_FX2, df_Act_Prod4, on='Product')
df_5.head()
```

Out[34]:

	Date_x	Product	Forecast Type	Forecast Units	Product Type_x	Date_y	Machine	Quantity	Shift	Product Type_y
0	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/2/2020	F-12	132	Shift#2	Cheddar & Sour

	Date_x	Product	Forecast Type	Forecast Units	Product Type_x	Date_y	Machine	Quantity	Shift	Product Type_y
1	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/16/2020	F-12	216	Shift#2	Cheddar & Sour
2	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/17/2020	F-12	348	Shift#1	Cheddar & Sour
3	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/31/2020	F-12	72	Shift#2	Cheddar & Sour
4	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	2/2/2020	F-12	324	Shift#2	Cheddar & Sour

In [35]:

```
# Create the new column 'Percentage'

df_5['Percentage'] = (df_5['Quantity'] / df_5['Forecast Units']) * 100
df_5.head()
```

Out[35]:

	Date_x	Product	Forecast Type	Forecast Units	Product Type_x	Date_y	Machine	Quantity	Shift	Product Type_y	Percentage
0	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/2/2020	F-12	132	Shift#2	Cheddar & Sour	8.616188
1	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/16/2020	F-12	216	Shift#2	Cheddar & Sour	14.099217
2	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/17/2020	F-12	348	Shift#1	Cheddar & Sour	22.715405
3	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	1/31/2020	F-12	72	Shift#2	Cheddar & Sour	4.699739
4	1/1/2020	Product 1	Production Forecast	1532	Cheddar & Sour	2/2/2020	F-12	324	Shift#2	Cheddar & Sour	21.148825

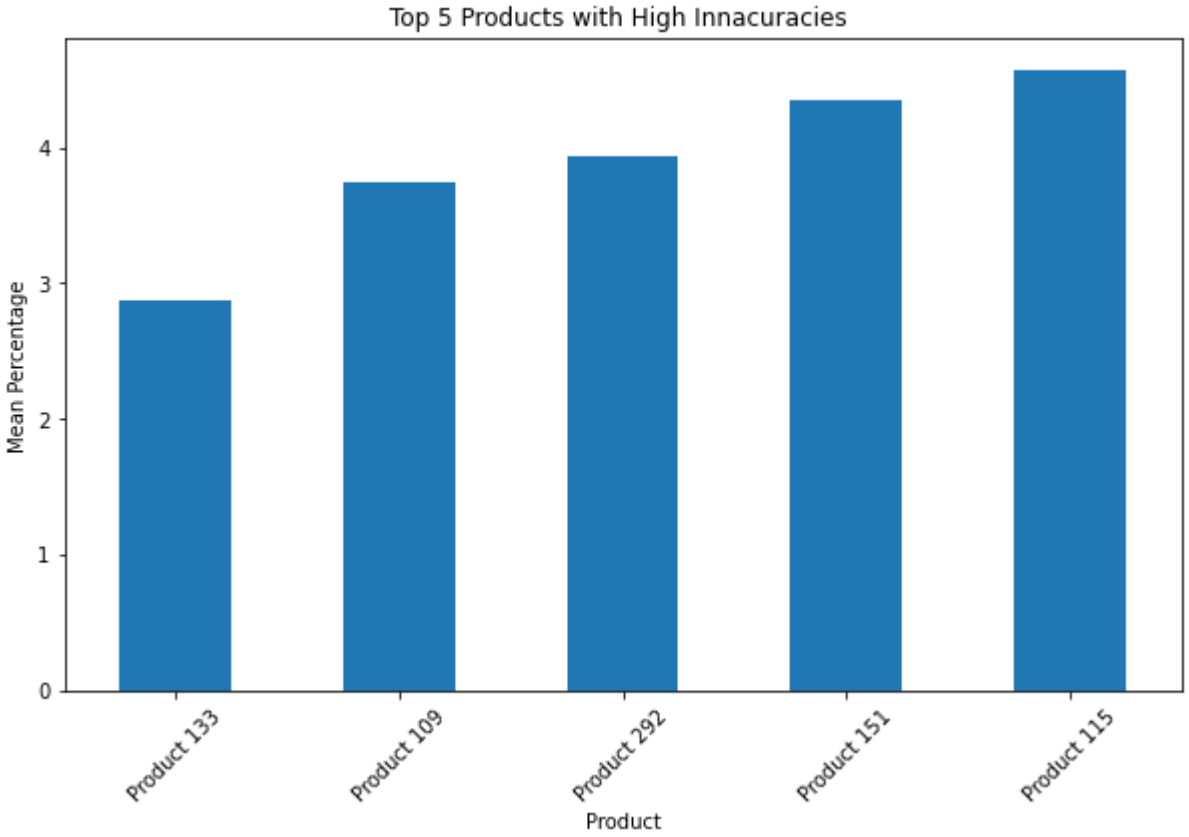
In [36]:

```
# Group by 'Product' and calculate the mean percentage for each group
grouped_df = df_5.groupby('Product')['Percentage'].mean()

# Sort the groups based on the mean percentage and select the top 10 lowest groups
top_5_lowest = grouped_df.nsmallest(5)
```

In [37]:

```
# Plot the top 5 Products with high innacuracies
plt.figure(figsize=(10, 6))
top_5_lowest.plot(kind='bar')
```

```
plt.xlabel('Product')
plt.ylabel('Mean Percentage')
plt.title('Top 5 Products with High Innacuracies ')
plt.xticks(rotation=45)
plt.show()
```



Business Questions to solve:

1. How many shortages of orders (compare Sales Orders vs Finished Goods Inventory?)

In [38]:

```
# Get the Inventory Closing per Product

df_Prod_Inv = df_Fin_Inv.merge(df_Products, on='Product', how='left')
df_Prod_Inv.drop(df_Prod_Inv.iloc[:, 2:5], axis=1, inplace=True)
df_Prod_Inv.head()
```

Out[38]:

	Date	Product	Closing	Product Type
0	5/24/2022	Product 1	129	Cheddar & Sour
1	5/24/2022	Product 2	877	Cheddar & Sour
2	5/24/2022	Product 3	1593	Cheddar & Sour
3	5/24/2022	Product 4	463	Cheddar & Sour
4	5/24/2022	Product 5	2284	Cheddar & Sour

In [39]:

```
# Get the total Sales Order per Product

df_Prod_SO3 = df_SO2.merge(df_Products, on='Product', how='left')
df_Prod_SO3.drop(df_Prod_SO3.iloc[:, 1:15], axis=1, inplace=True)
df_Prod_SO3.head()
```

Out[39]:

	Product	SO SUM	Product Type
0	Product 1	36	Cheddar & Sour
1	Product 2	792	Cheddar & Sour
2	Product 3	525	Cheddar & Sour
3	Product 4	0	Cheddar & Sour
4	Product 5	5364	Cheddar & Sour

In [40]:

```
# Merge dataframes on 'Product' column
df_merged = df_Prod_SO3.merge(df_Prod_Inv, on='Product', how='left')

# Calculate the shortage of orders
df_merged['Shortage'] = df_merged['SO SUM'] - df_merged['Closing']
```

In [41]:

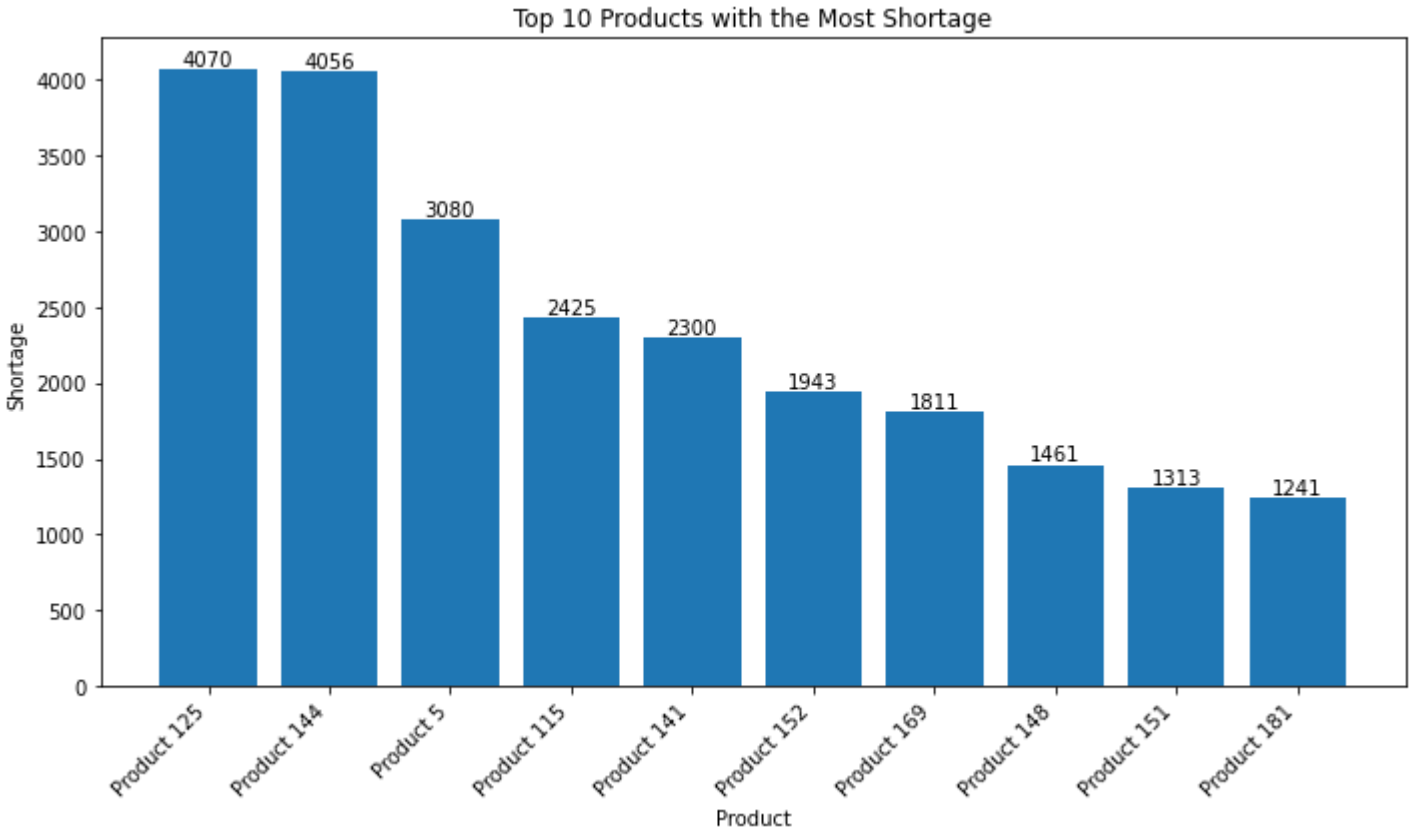
```
# Fill non-finite values with 0 in 'Closing' column
df_merged['Closing'].fillna(0, inplace=True)
df_merged['Shortage'].fillna(0, inplace=True)

# Convert 'Closing' and 'Shortage' columns to integer
df_merged['Closing'] = df_merged['Closing'].astype(int)
```

```
df_merged['Shortage'] = df_merged['Shortage'].astype(int)

# Display the result
print(df_merged[['Product', 'SO SUM', 'Closing', 'Shortage']])
```

```
         Product  SO SUM  Closing  Shortage
0      Product 1      36      129       -93
1      Product 2     792      877       -85
2      Product 3     525     1593     -1068
3      Product 4       0      463      -463
4      Product 5    5364     2284      3080
..           ...     ...      ...       ...
176  Product 203       0     1916     -1916
177  Product 204       0     1184     -1184
178  Product 205       0      793      -793
179  Product 206       0       18       -18
180  Product 208       0        1        -1

[181 rows x 4 columns]
```

In [42]:

```
# Sort the dataframe by 'Shortage' column in descending order
df_sorted = df_merged.sort_values(by='Shortage', ascending=False)

# Select the top 10 products with the most shortage
top_10_products = df_sorted.head(10)

# Create a bar plot
plt.figure(figsize=(10, 6))
plt.bar(top_10_products['Product'], top_10_products['Shortage'])
plt.xlabel('Product')
plt.ylabel('Shortage')
plt.title('Top 10 Products with the Most Shortage')
plt.xticks(rotation=45, ha='right')

# Add shortage values as text annotations above each bar
for index, value in enumerate(top_10_products['Shortage']):
    plt.text(index, value, str(value), ha='center', va='bottom')

plt.tight_layout()
plt.show()
```



Business Questions to solve:

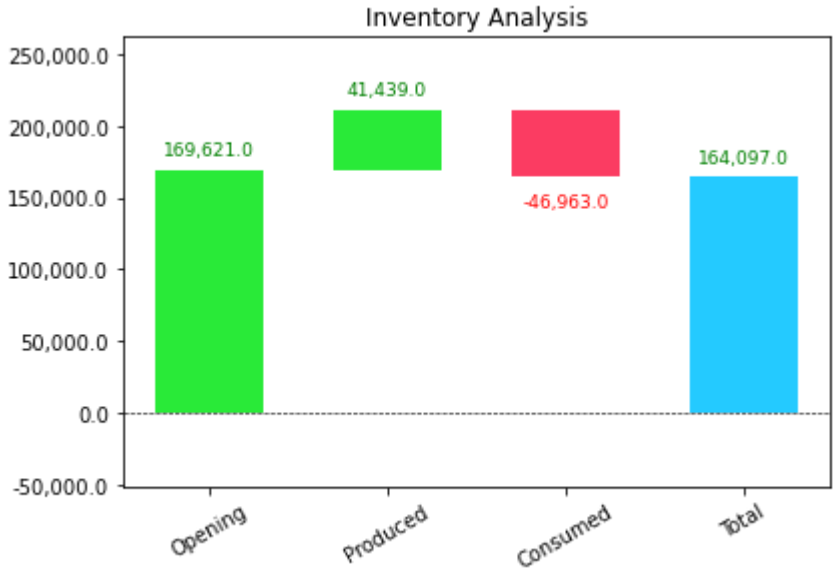
1. Calculate Sell-through rate: Sell-through rate = (Units Consumed/Units Produced)

In [43]:
```
Sell_through_rate = (df_Fin_Inv["Consumed"].sum()/ df_Fin_Inv["Produced"].sum())

print(f'{round(Sell_through_rate, 2)}%')
```

```
-1.13%
```

In [44]:
```
a = ['Opening','Produced','Consumed']
b = [169621,41439,-46963]
waterfall_chart.plot(a, b, net_label='Total');
plt.title('Inventory Analysis')
```

Out[44]: Text(0.5, 1.0, 'Inventory Analysis')



Business Questions to solve:

1. Identify items in Finished Goods Inventory for which we have no or low sales (consumed means sold).

In [45]:
```
# Join the dataframe (Product + Sales Order)

df_Prod_SO = pd.merge(df_SO, df_Products, on='Product')
```

In [46]:
```
# Check Items with no or low Sales

Stat_Prod_SO = df_Prod_SO.groupby('Product Type')['Quantity'].describe()
Stat_Prod_SO
```

Out[46]:

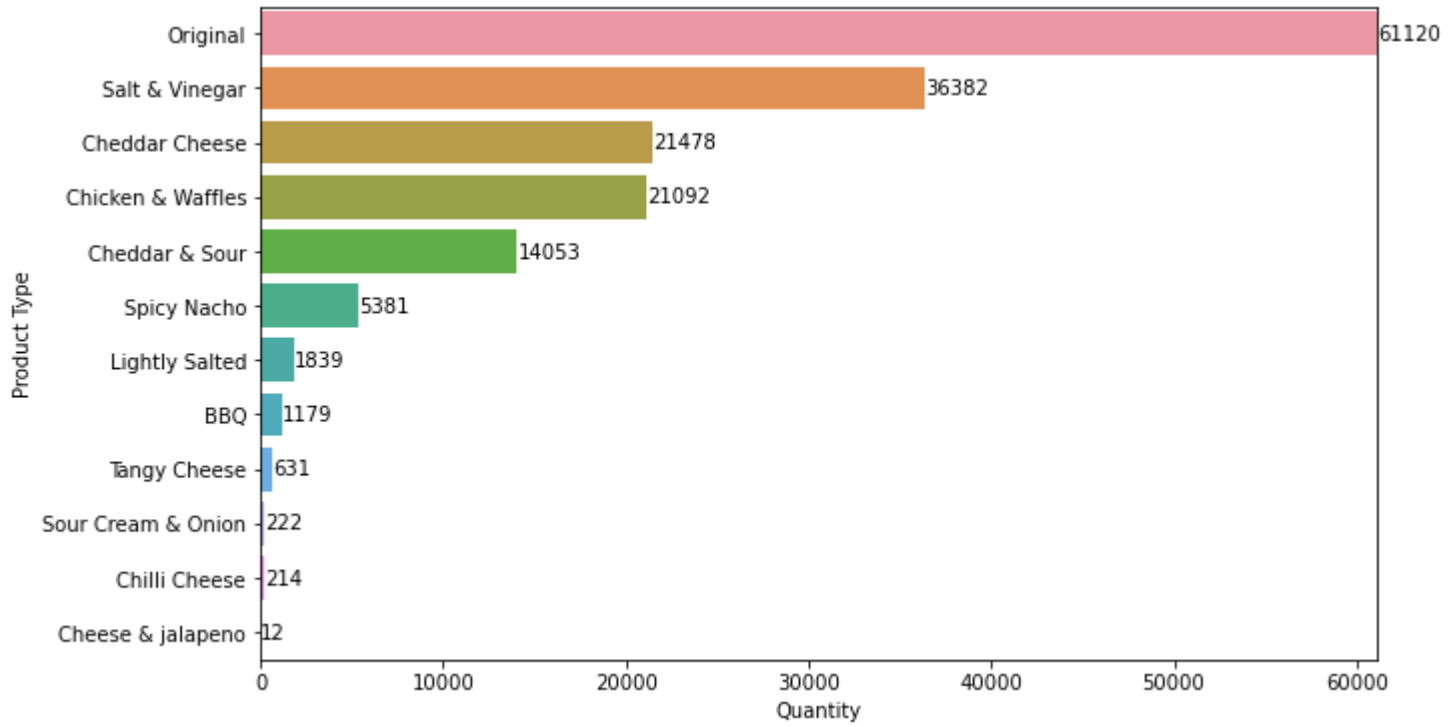
Product Type	count	mean	std	min	25%	50%	75%	max
BBQ	7.0	168.428571	270.421805	0.0	15.00	27.0	186.00	750.0
Cheddar & Sour	18.0	780.722222	738.144558	0.0	174.00	497.5	1353.50	2284.0

Product Type	count	mean	std	min	25%	50%	75%	max
Cheddar Cheese	20.0	1073.900000	1138.011003	79.0	416.75	672.0	932.25	3735.0
Cheese & jalapeno	2.0	6.000000	4.242641	3.0	4.50	6.0	7.50	9.0
Chicken & Waffles	28.0	753.285714	817.873750	0.0	173.50	504.0	953.75	3009.0
Chilli Cheese	5.0	42.800000	42.055915	2.0	2.00	44.0	67.00	99.0
Lightly Salted	7.0	262.714286	529.779424	1.0	8.50	28.0	171.00	1451.0
Original	35.0	1746.285714	2062.053767	0.0	423.50	960.0	1891.50	8196.0
Salt & Vinegar	40.0	909.550000	765.208869	14.0	347.00	640.5	1289.75	2989.0
Sour Cream & Onion	2.0	111.000000	98.994949	41.0	76.00	111.0	146.00	181.0
Spicy Nacho	9.0	597.888889	590.919928	0.0	86.00	410.0	1280.00	1383.0
Tangy Cheese	8.0	78.875000	100.093438	2.0	8.25	27.5	125.00	251.0

In [47]:
```
# Group the data and calculate the sum of Quantity for each Product Type
df_grouped = df_Prod_SO.groupby('Product Type')['Quantity'].sum().reset_index()

# Sort the df_grouped DataFrame based on Quantity in descending order
df_grouped = df_grouped.sort_values(by='Quantity', ascending=False)

# Create a new DataFrame for plotting
df_plot = pd.DataFrame({'Product Type': df_grouped['Product Type'], 'Quantity': df_grouped['Quantity']})
```

In [48]:
```
# Set the size of the plot
plt.figure(figsize=(10, 6))

# Create a horizontal bar plot using seaborn
sns.barplot(x='Quantity', y='Product Type', data=df_plot)

# Annotate each bar with its value (as integer)
for index, value in enumerate(df_grouped['Quantity']):
    # Adjust the x-coordinate and text alignment for the annotations
    plt.text(value + 5, index, f'{int(value)}', ha='left', va='center')

# Set the x-axis limit to make space for annotations
```

```
plt.xlim(right=df_grouped['Quantity'].max() + 10)

# Show the plot
plt.show()
```



Business Questions to solve:

1. Fill rate = [(*Total Units in inventory-Consumed Units)/Total Units in inventory]* 100

*Total Units in inventory = Opening + Produced

In [49]:
```
Fill_rate = (((df_Fin_Inv["Opening"].sum() + df_Fin_Inv["Produced"].sum())- df_Fin_Inv["Consumed"].sum())
             /(df_Fin_Inv["Opening"].sum() + df_Fin_Inv["Produced"].sum()))

print(f'{round(Fill_rate, 2)}%')
```

```
1.22%
```

Business Questions to solve:

1. Predict the remaining 2022 forecast using Actual Production vs Production Forecast.

In [50]:

Business Questions to solve:

1. Predict the 2022 sales team performance using Sales Forecast vs Production Forecast.

In [ ]: