Supplier Quality Analysis

Promblem Overview

- **Benchmark** supplier quality by evaluating the number and type of defects across various materials.
- **Identify** which suppliers or materials are consistently underperforming.
- **Provide** actionable insights for improving supplier selection and quality control processes.

OUR TEAM

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Analysis Goals

01 Benchmark Supplier Quality

02 Find Weak Suppliers

03 Improve Quality Control

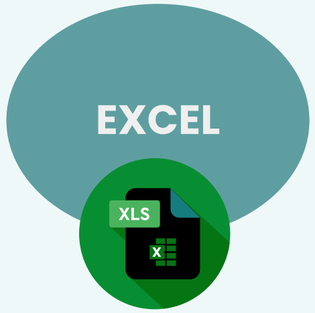
04 Analyze Defect Trends

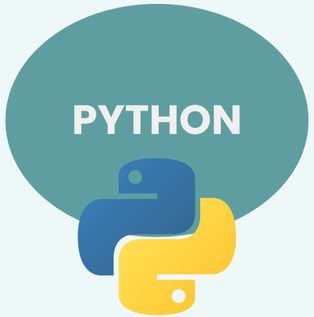
05 Optimize Supplier Management

06 Enhance Supply Chain Efficiency

Process

Explore Data → **Maniupilate, Clean Data** → **Visualization**





Material ID

Plant ID

Defect Type ID

Material Type ID

Defect QTY

10 Columns

6,145 rows

Vendor ID

Sub Category ID

Defect ID

Downtime (min)

Date

Data Exploration

Data Characteristics

Date:

- Dates are available for use in analysis.

Defect Quantity & Downtime:

- Quantitative data for defects and downtime in integer and float formats.

ID Columns:

- Identification columns linking vendors, materials, and defect types.

Data Exploration

Data Quality

Missing Values:

- 1 missing value in the Downtime column; all other fields are complete.

Weird Record:

- This weird record has no Downtime minutes and contains all the missing references.

Defect Quantities:

- Significant range with extremes (e.g., max defect quantity of 42,275), requiring closer examination for outlier handling.

Data Exploration

Data Quality

Duplicates:

- Found duplicates in the Vendor and Defects dimensions.

Plant Column Issue:

- Plant column in the Plant dimension has two values separated by a comma (",").

Material ID:

- Material ID column in the Defected Items Fact table doesn't have reference data for each material.

Data Exploration

Data Quality

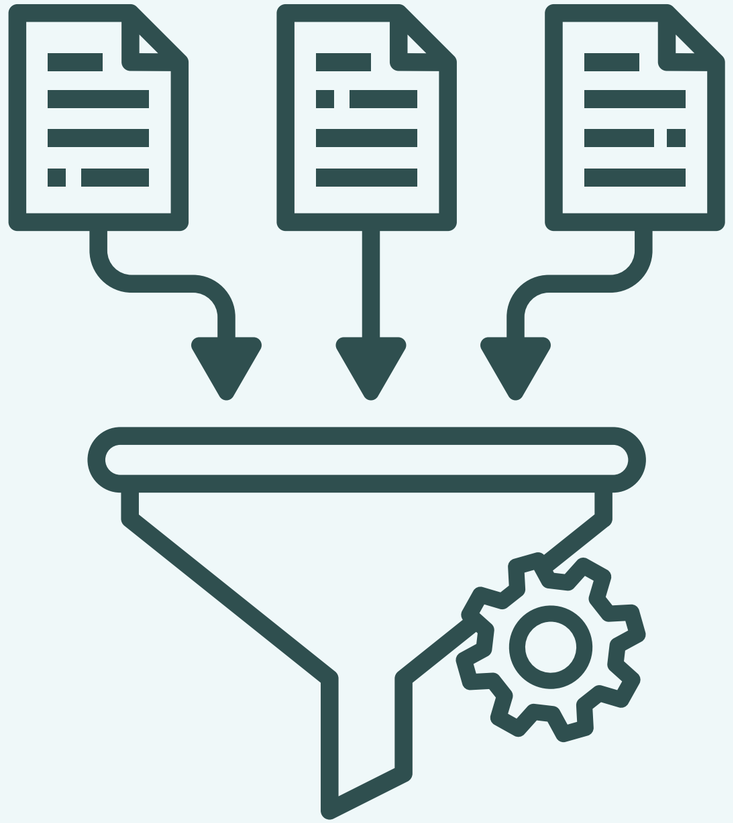
Date Format:

- Date column in Defected Items Fact is stored as a timestamp, but there are no changes in hours, minutes, and seconds.

Unreferenced IDs:

- Vendor ID "810" is missing from the Vendor dimension.
- Defect Type ID "8" is missing from the Defect Type dimension.
- Material Type ID "69" is missing from the Material Type dimension.
- These unreferenced IDs are all found in one record without any repeats in other records.

Cleaning



Data Cleaning

Removals

- Found and removed duplicates in the Vendor dimension.

```
# drop the duplicates without the first occurrence from vendor

vendor = vendor.drop_duplicates(subset='Vendor', keep='first')
```

- Found and removed duplicates in the Vendor dimension.

```
defects = defects.drop_duplicates(subset='Defect', keep='first')
```

Data Cleaning

Removals

- Removed the "weird" record that has all the incorrect data.

```
# Delete row that have Defect Type ID = 8 in defected_items

defected_items = defected_items[defected_items['Defect Type ID'] != 8]
```

Data Cleaning

Replacements

- Found and replaced all records in the Defected Items Fact that have duplicate Vendor IDs with the unique Vendor ID.

```
# Step 1: Identify the first occurrence of each duplicated vendor
first_occurrences = vendor.drop_duplicates(subset='Vendor', keep='first')

# Step 2: Create a mapping of all vendor names to their first occurrence Vendor ID
vendor_mapping = dict(zip(vendor['Vendor'], vendor['Vendor ID']))

# Step 3: Create a reverse mapping for duplicates (replace duplicate Vendor IDs with first occurrence)
for vendor_name in first_occurrences['Vendor']:
    first_id = first_occurrences[first_occurrences['Vendor'] == vendor_name]['Vendor ID'].values[0]
    duplicate_ids = vendor[vendor['Vendor'] == vendor_name]['Vendor ID'].tolist()

    # Update the mapping for all duplicate IDs
    for dup_id in duplicate_ids:
        vendor_mapping[dup_id] = first_id

# Step 4: Apply this mapping to update the 'Vendor ID' in defected_items DataFrame
defected_items['Vendor ID'] = defected_items['Vendor ID'].replace(vendor_mapping)
```

Data Cleaning

Replacements

- Found and replaced all records in the Defected Items Fact that have duplicate Defect IDs with the unique Defect ID.

```
# Step 1: Identify the first occurrence of each duplicated vendor
first_occurrences_defects = defects.drop_duplicates(subset='Defect', keep='first')

# Step 2: Create a mapping of all vendor names to their first occurrence Vendor ID
defects_mapping = dict(zip(defects['Defect'], defects['Defect ID']))

# Step 3: Create a reverse mapping for duplicates (replace duplicate Vendor IDs with first occurrence)
for defect_name in first_occurrences_defects['Defect']:
    first_id = first_occurrences_defects[first_occurrences_defects['Defect'] == defect_name]['Defect ID'].values[0]
    duplicate_ids = defects[defects['Defect'] == defect_name]['Defect ID'].tolist()

    # Update the mapping for all duplicate IDs
    for dup_id in duplicate_ids:
        defects_mapping[dup_id] = first_id

# Step 4: Apply this mapping to update the 'Vendor ID' in defected_items DataFrame
defected_items['Defect ID'] = defected_items['Defect ID'].replace(defects_mapping)
```

Data Cleaning

Updates

- Updated the Plant table by separating the Plant column into two columns: Plant and State.

```
# seperate the Plant column in plant dataframe to 2 columns by comma , and drop the Plant column

plant[['Plant', 'State']] = plant['Plant'].str.split(',', expand=True)

plant
```

Data Cleaning

Updates

- Added three more columns to the Plant table: State Name (derived from the State column), Longitude, Latitude.
- Changed the Date column type in the Fact table from timestamp to just date.

```
plant['State Name'] = plant['State'].str.strip().str.upper().map(
    {'MI': 'Michigan',
     'WI': 'Wisconsin',
     'IL': 'Illinois',
     'IN': 'Indiana',
     'OH': 'Ohio',
     'IA': 'Iowa'})

plant
```

```
plant['Longitude'] = plant['State Name'].map(
    {'Michigan': -84.506836,
     'Wisconsin': -89.500000,
     'Illinois': -89.000000,
     'Indiana': -86.126976,
     'Ohio': -82.996216,
     'Iowa': -93.581543})
plant['Latitude'] = plant['State Name'].map(
    {'Michigan': 44.182205,
     'Wisconsin': 44.500000,
     'Illinois': 40.000000,
     'Indiana': 40.273502,
     'Ohio': 40.367474,
     'Iowa': 42.032974})

plant
```

Data Cleaning

Additions

- Created a Calendar dimension to help in visualizing data containing six columns: Date, Year, Quarter, Month, Name of Month, Day.

```
# Define the date range
date_range = pd.date_range(start='2012-01-01', end='2024-12-31', freq='D')

# Create a DataFrame
calendar_df = pd.DataFrame({
    'Date': date_range,
    'Year': date_range.year,
    'Quarter': date_range.quarter,
    'Month': date_range.month,
    'Name of Month': date_range.strftime('%B'),  # Full month name
    'Day': date_range.day
})
```

Data Cleaning

Additions

- Created a Group By table to help in the benchmark story between vendors

```
# Group the data by Vendor ID
grouped_by_vendor = defected_items.groupby('Vendor ID')

# You can also aggregate the data, for example, summing up defect quantities and downtime minutes
aggregated_data = grouped_by_vendor.agg({
    'Defect Qty': 'sum',
    'Downtime min': 'sum'
}).reset_index()

# Display the aggregated data
aggregated_data
```

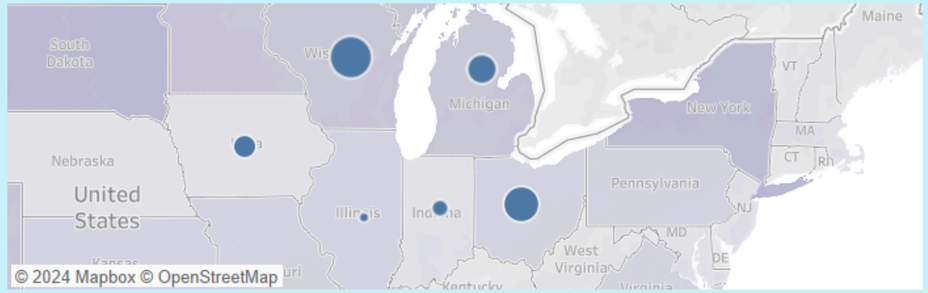
Our Insights

Suppliers Quality Dashboard

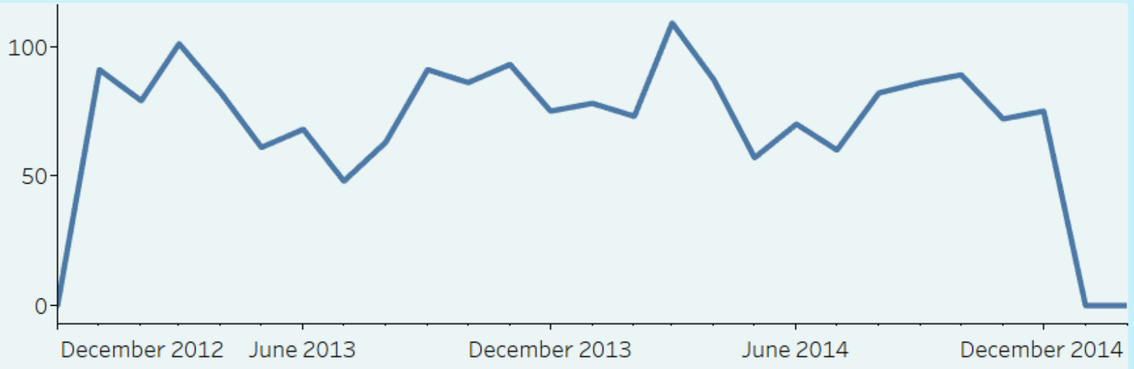
Next

# Defected Items	Qty	Total Downtime..	Max. Downtime ..	# of Vendors	# of Defect
6,144	36,942,501	87,121	90	326	268

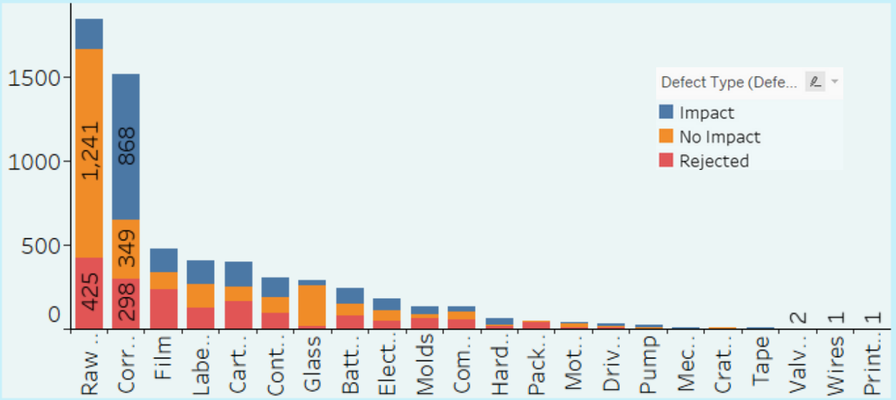
Total Qty Per Plants Geo



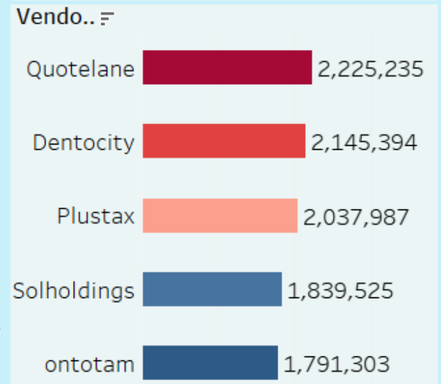
No. of Defects Over Time



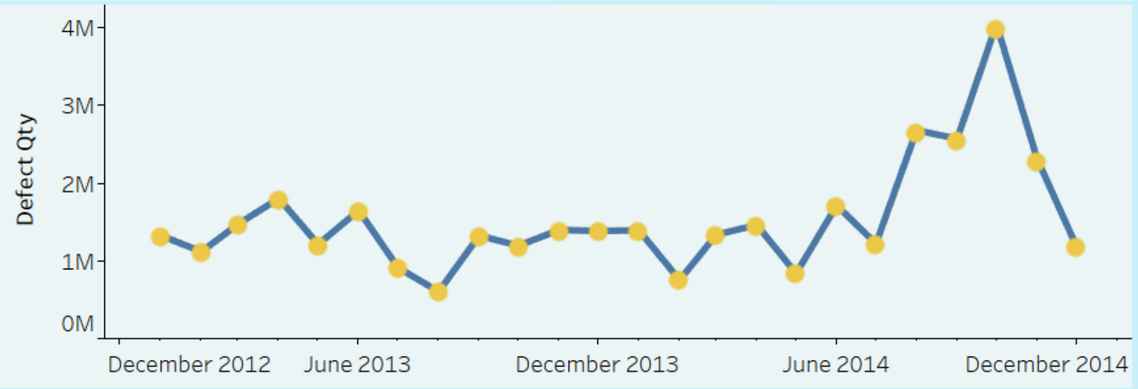
Defect Type by Material Type



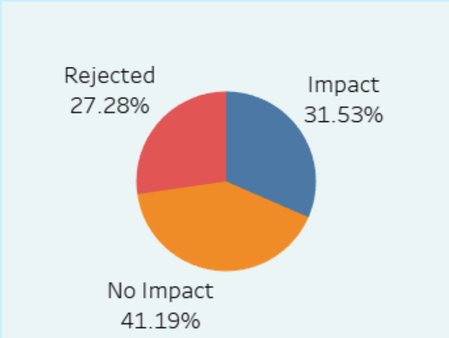
Total Qty Per Vendor



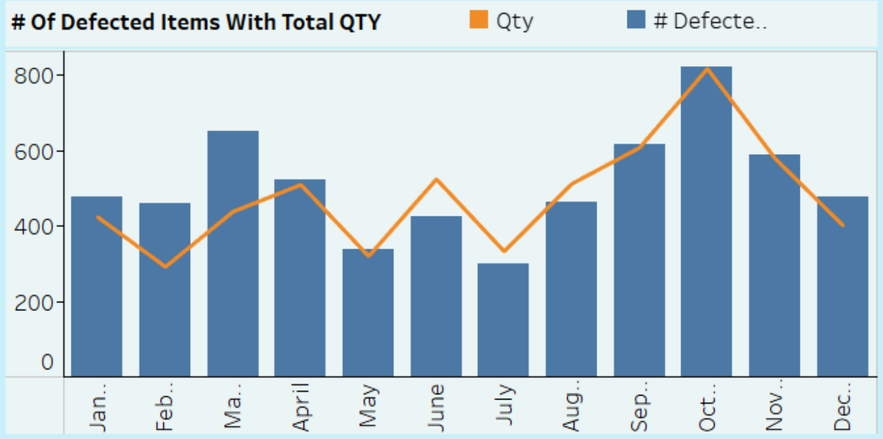
Total Quantity Over Years



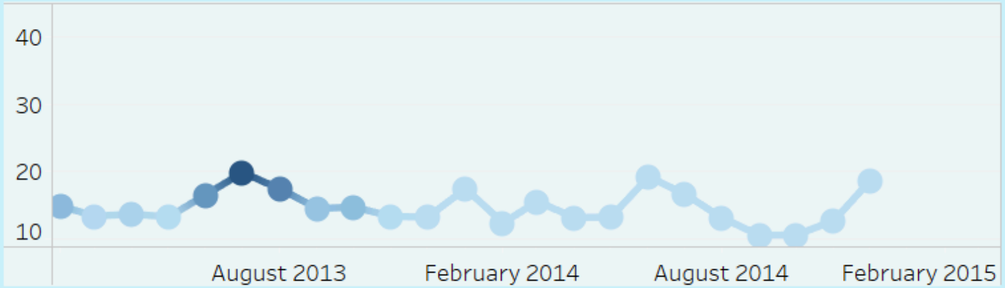
% Of Defected Items



Of Defected Items With Total QTY

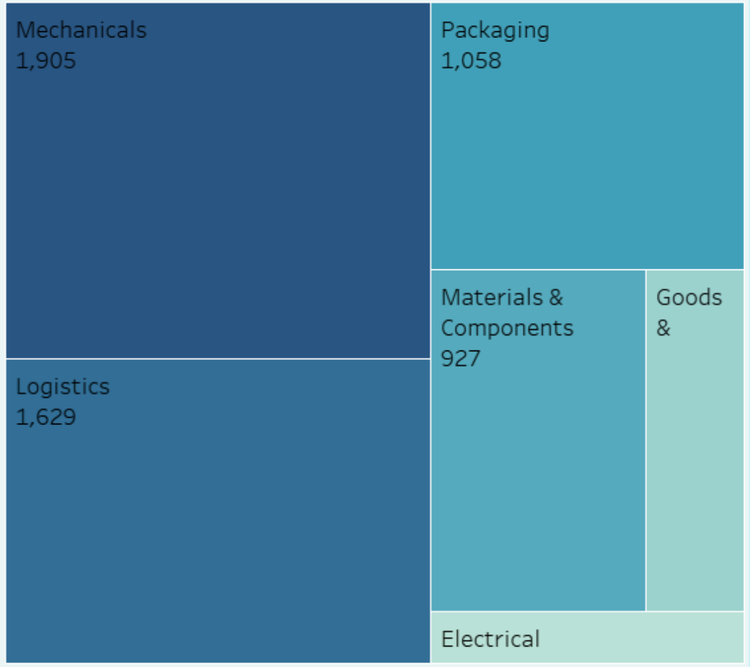


Avg. DownTime mins Over Years

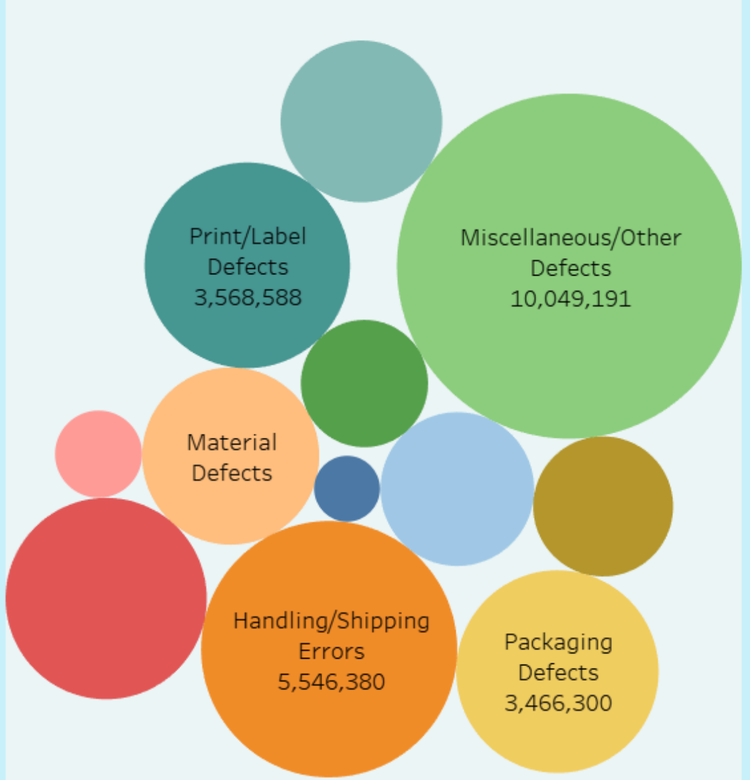


Previous Next

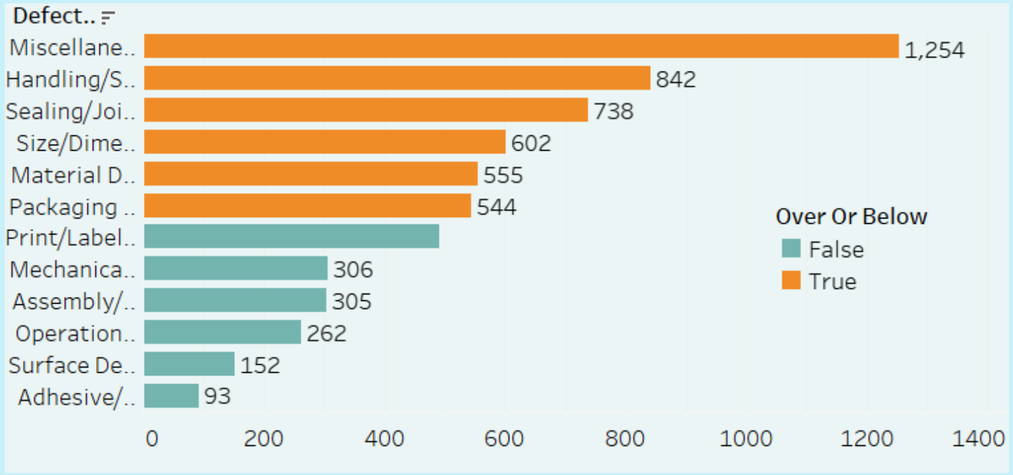
OF Defected Items By Category



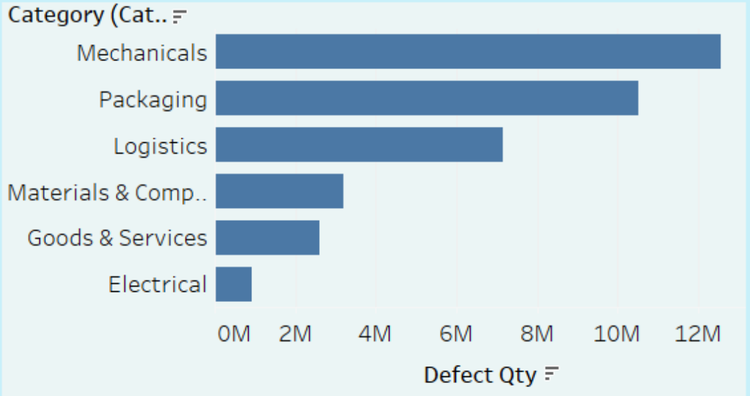
Qty For Each Defect Type



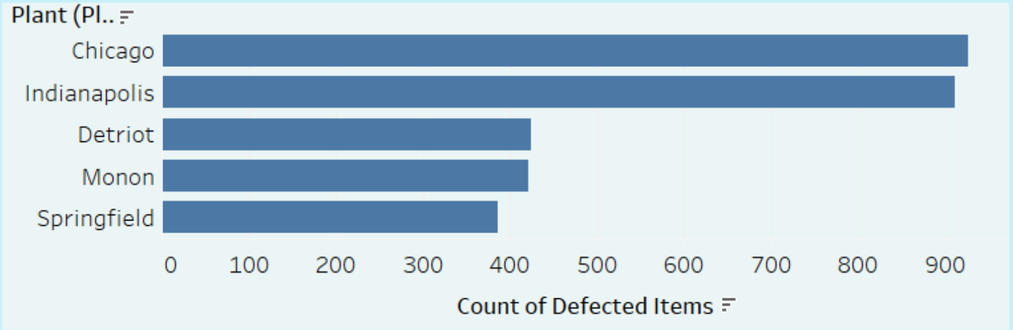
of Defected Items Per Defect Category



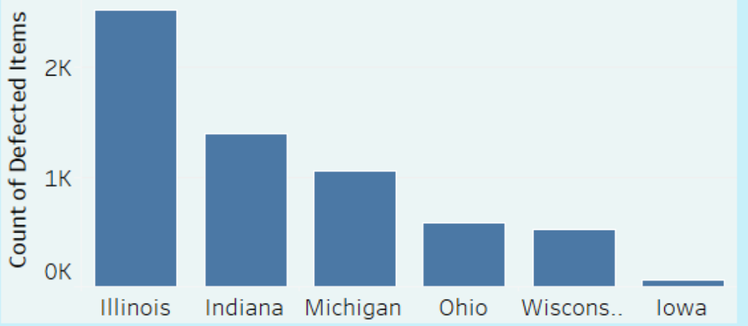
The Most Material Category Per QTY



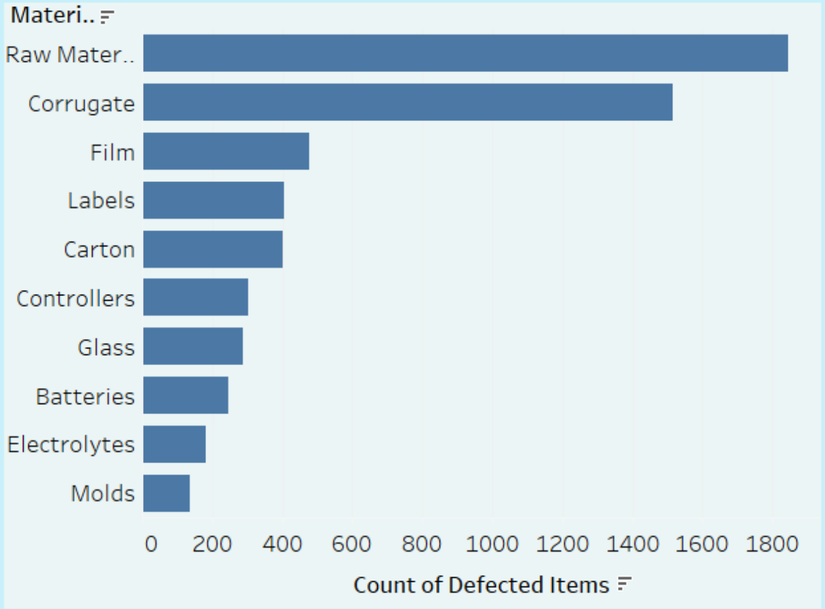
Top 5 Plants in # of Defected Items



Defected Items In Each State

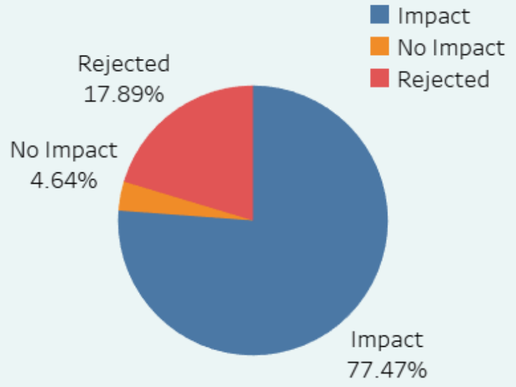


Of Defected Items Per Material Type

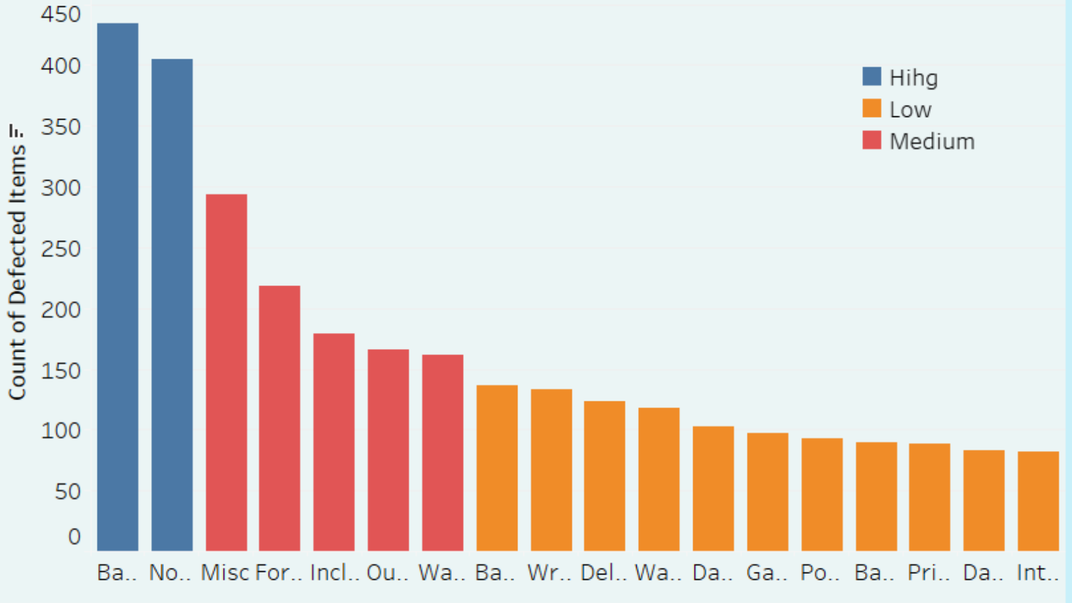


Previous

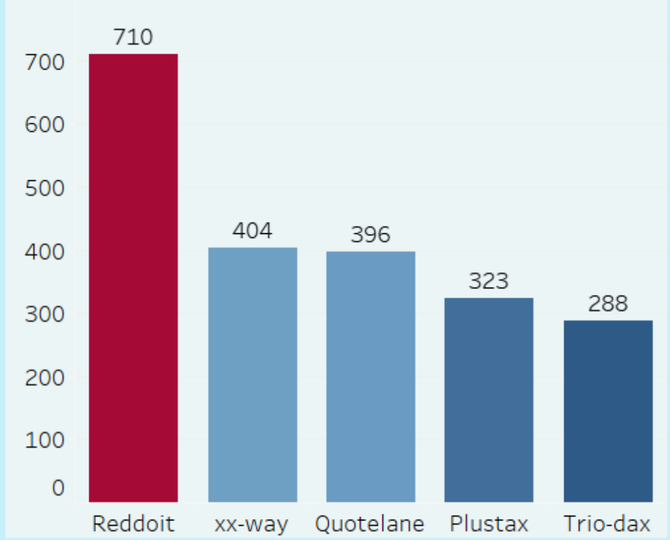
AVG. DownTime



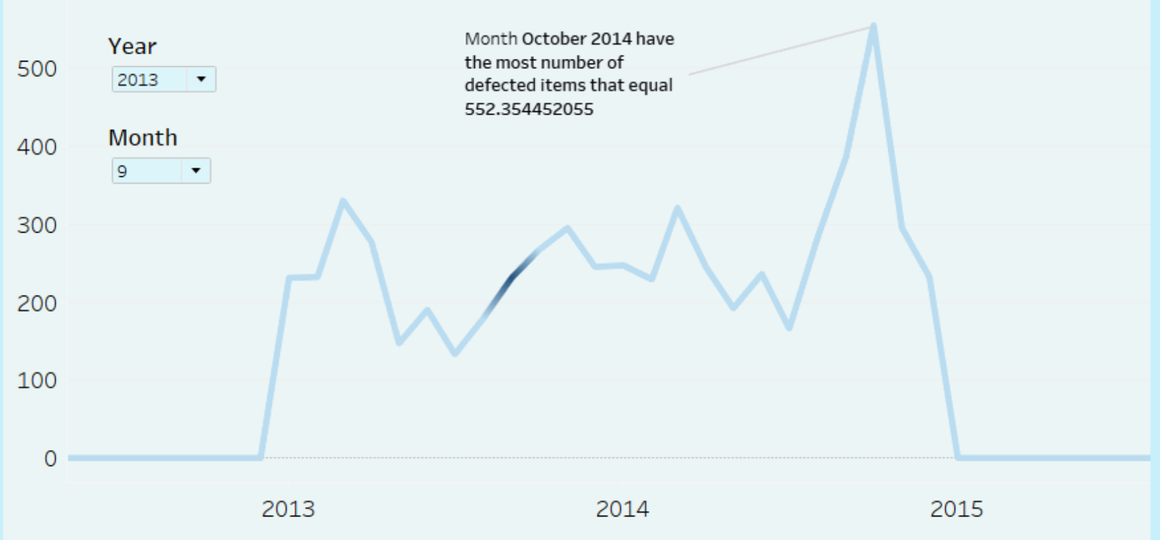
Defect Severity



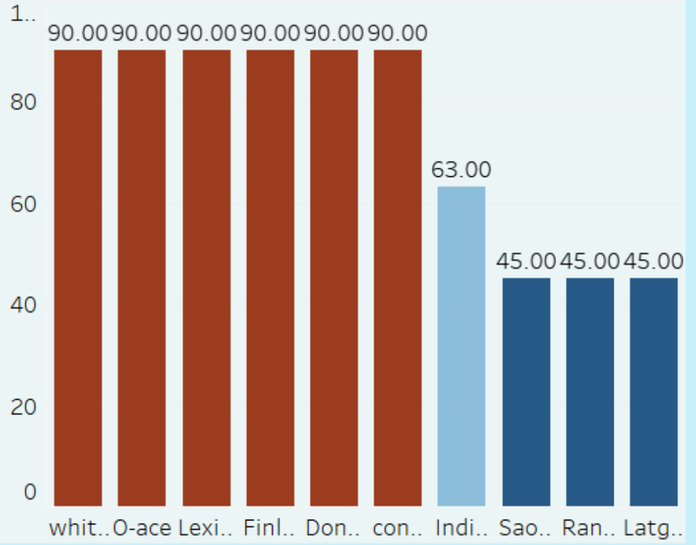
The Top Worest 5 Vendors



of Defect Items Over Months



Top 10 Vendors



Total Defected QTY

36 M

Total DownTime (hr)

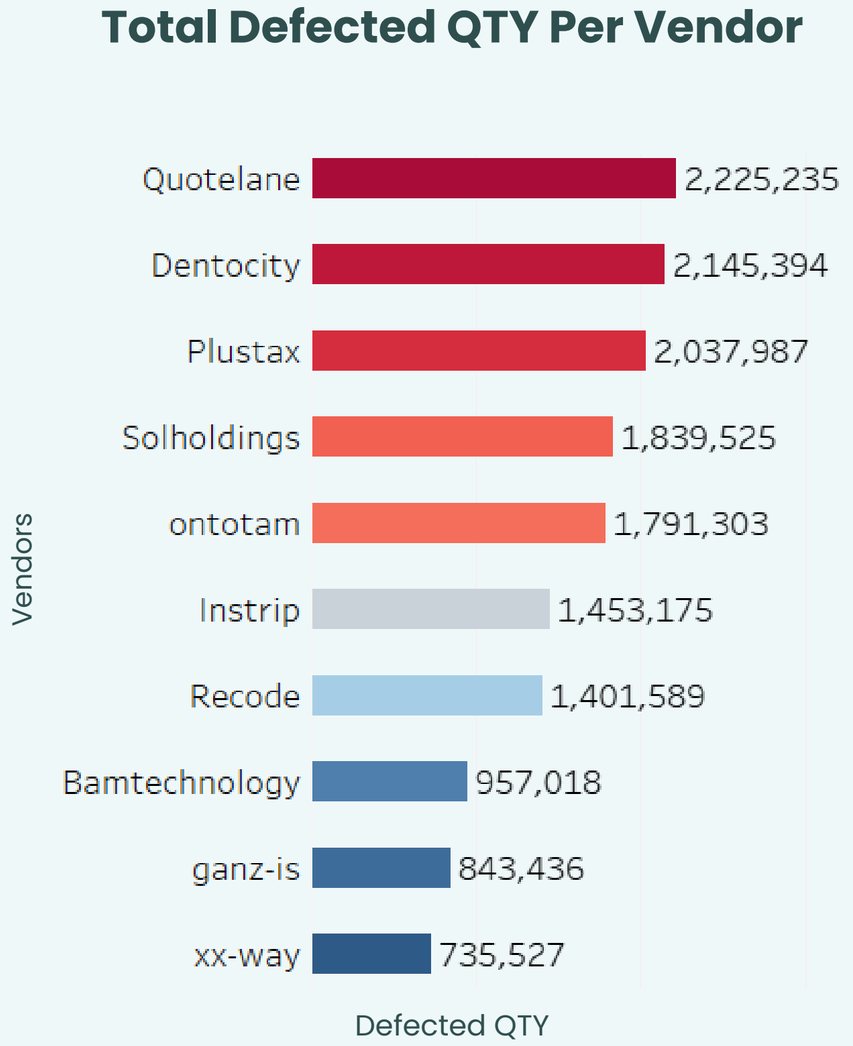
1453 h

Nom Of Defected Items

6144

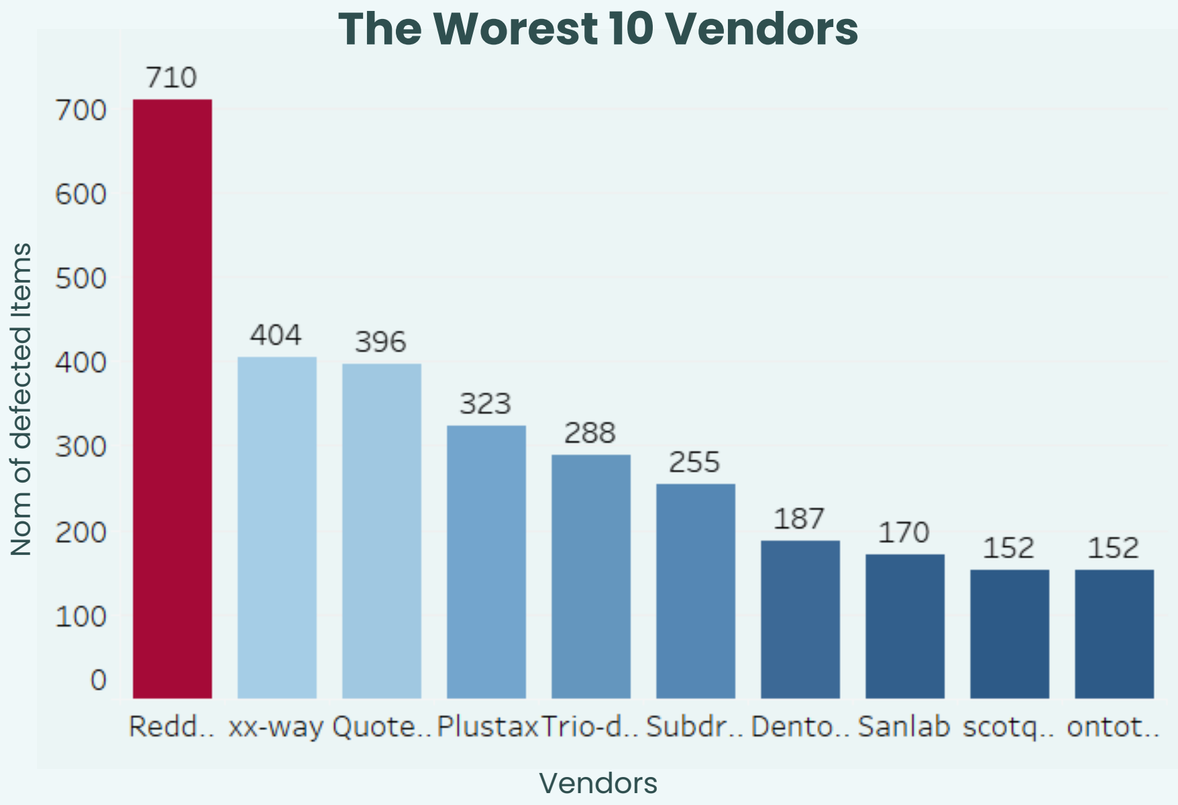
Vendors

- **Quotelane** has the highest total quantity of defective items, surpassing all other vendors in terms of overall defects.
- The final vendor in the top 5 worst performers is **Ontotam**, rounding out the group.



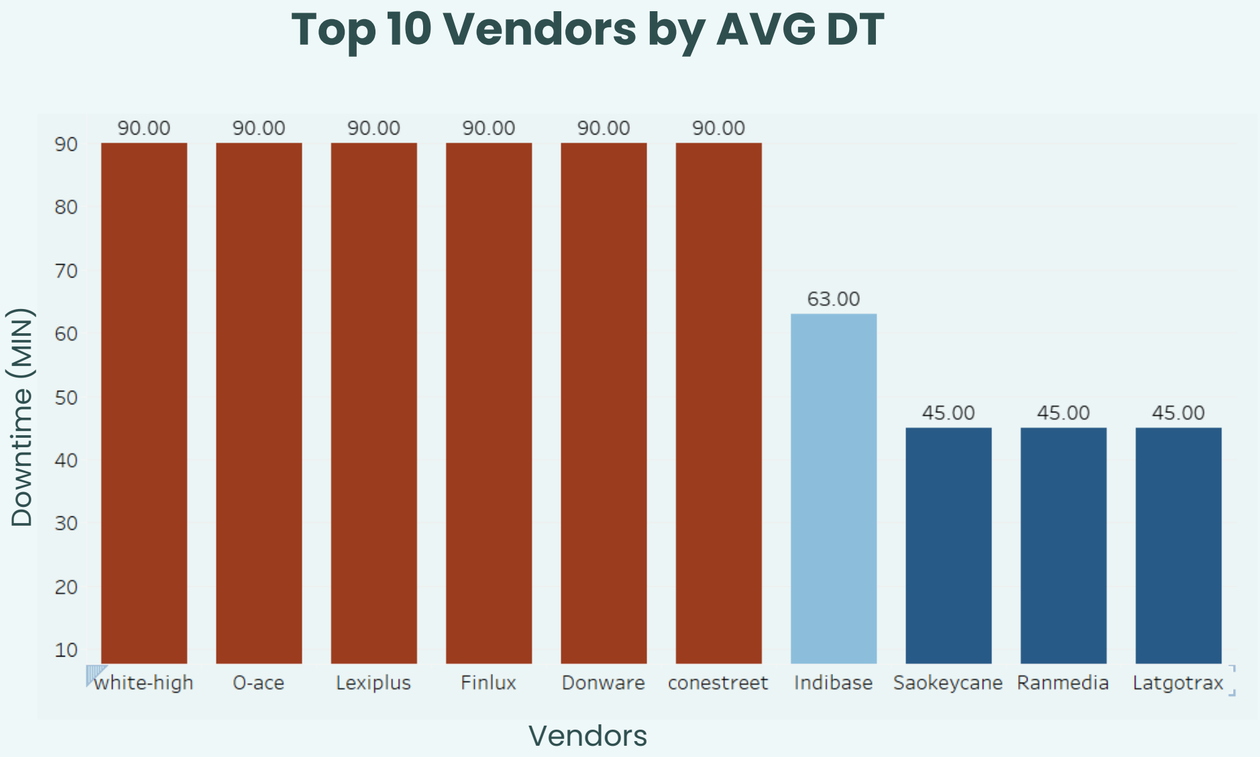
Vendors

- **Reddoit** is the worst-performing vendor, with a notably higher number of defects —710 defective items—making it stand out significantly from other vendors.
- The vendors **Plustax** and Trio-dax, with 323 and 288 defective items respectively, are also among the top 5 worst performers, though their defect counts are considerably lower than Reddoit.



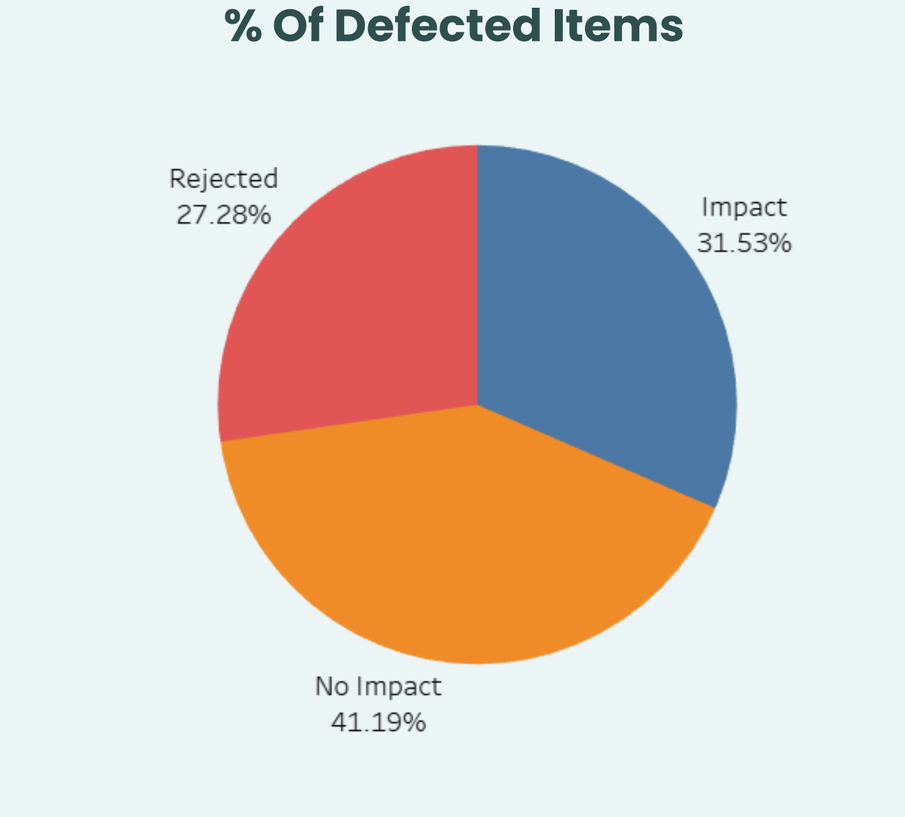
Vendors

- The first six vendors—**White-High, O-Ace, Lexiplus, Finlux, Donware**, and **Conestreet**—exhibit an exceptionally high average downtime of approximately **90 minutes**, significantly exceeding that of other vendors.
- In contrast, the last three vendors, **Saokeycane, Ranmedia,** and **Latgotrax**, have average downtimes of **45 minutes**, which is notably lower than the top five vendors.



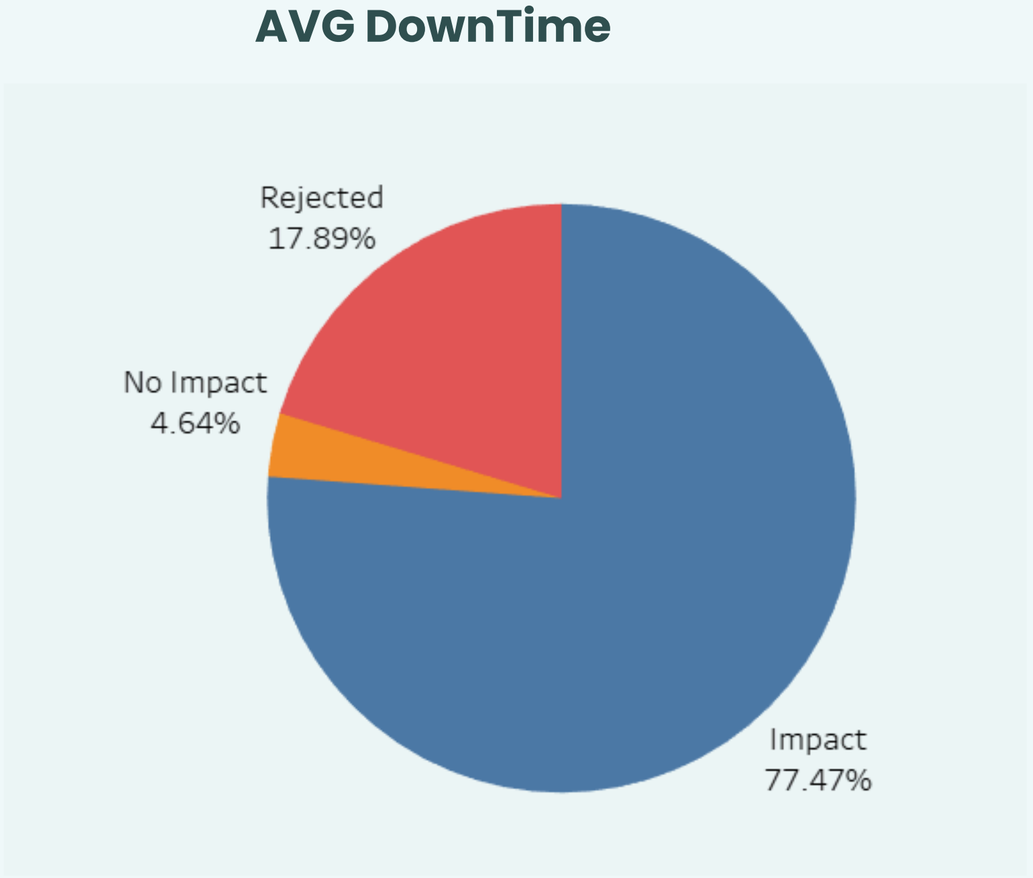
Defect Type

- The **No Impact** type accounts for the highest percentage of defective items, making it the most common category.
- The **Impact** and **Rejected** types have similar proportions; however, **Rejected** represents the smallest percentage among them.



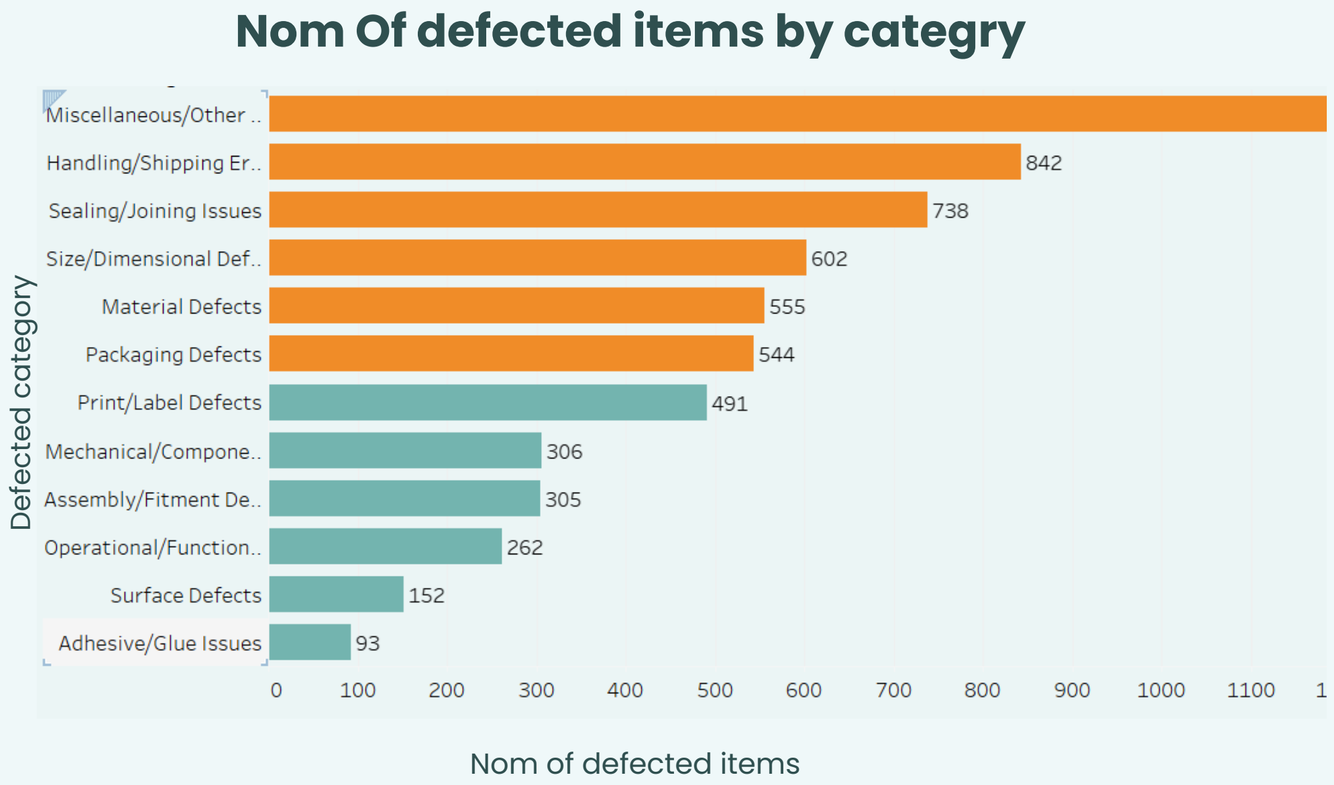
Defect Type

- The **Impact** category has the highest percentage of average downtime in minutes, indicating it contributes significantly to overall downtime.



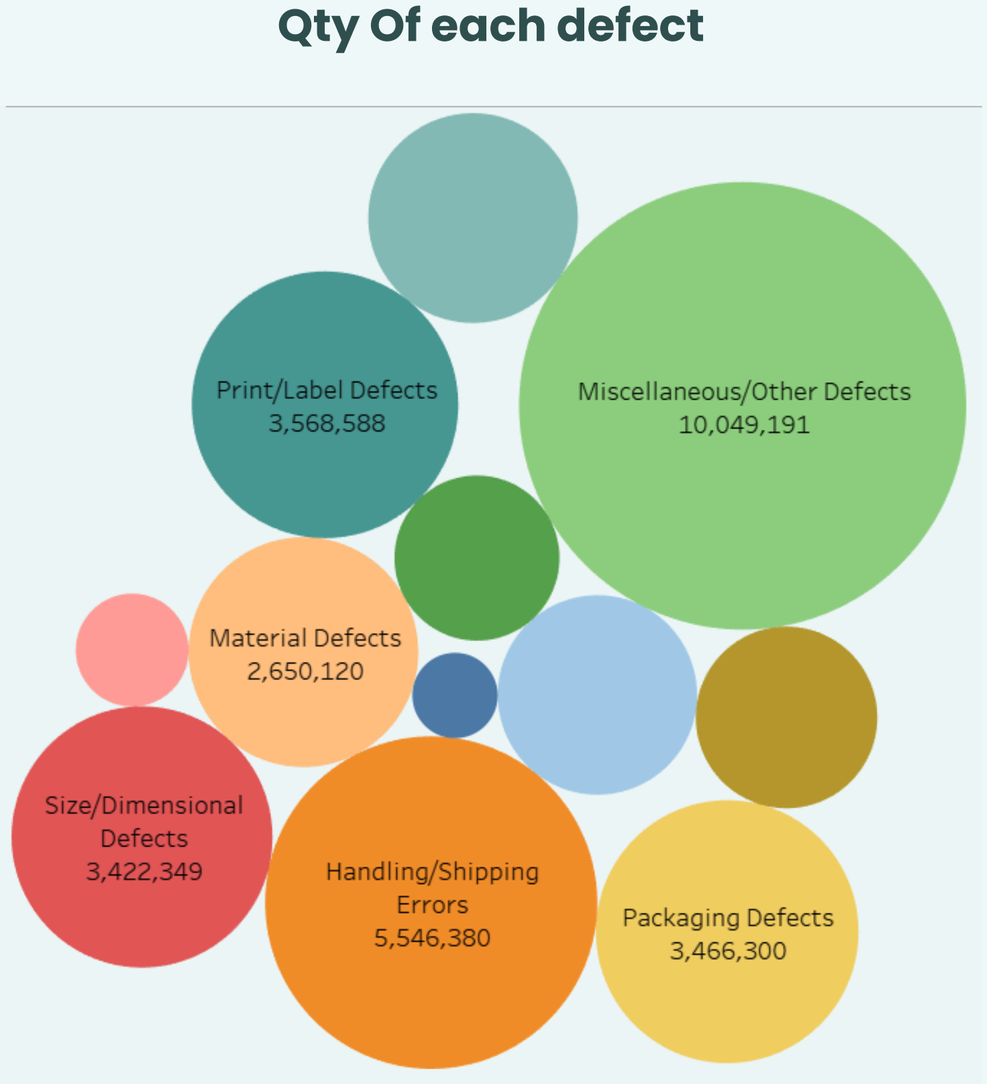
Defects

- The data illustrates the number of defective items for each defect category, indicating whether the count is above or below the average.
- It shows that the **Miscellaneous/Other Defects** category is the most affected, with the largest number of defective items.



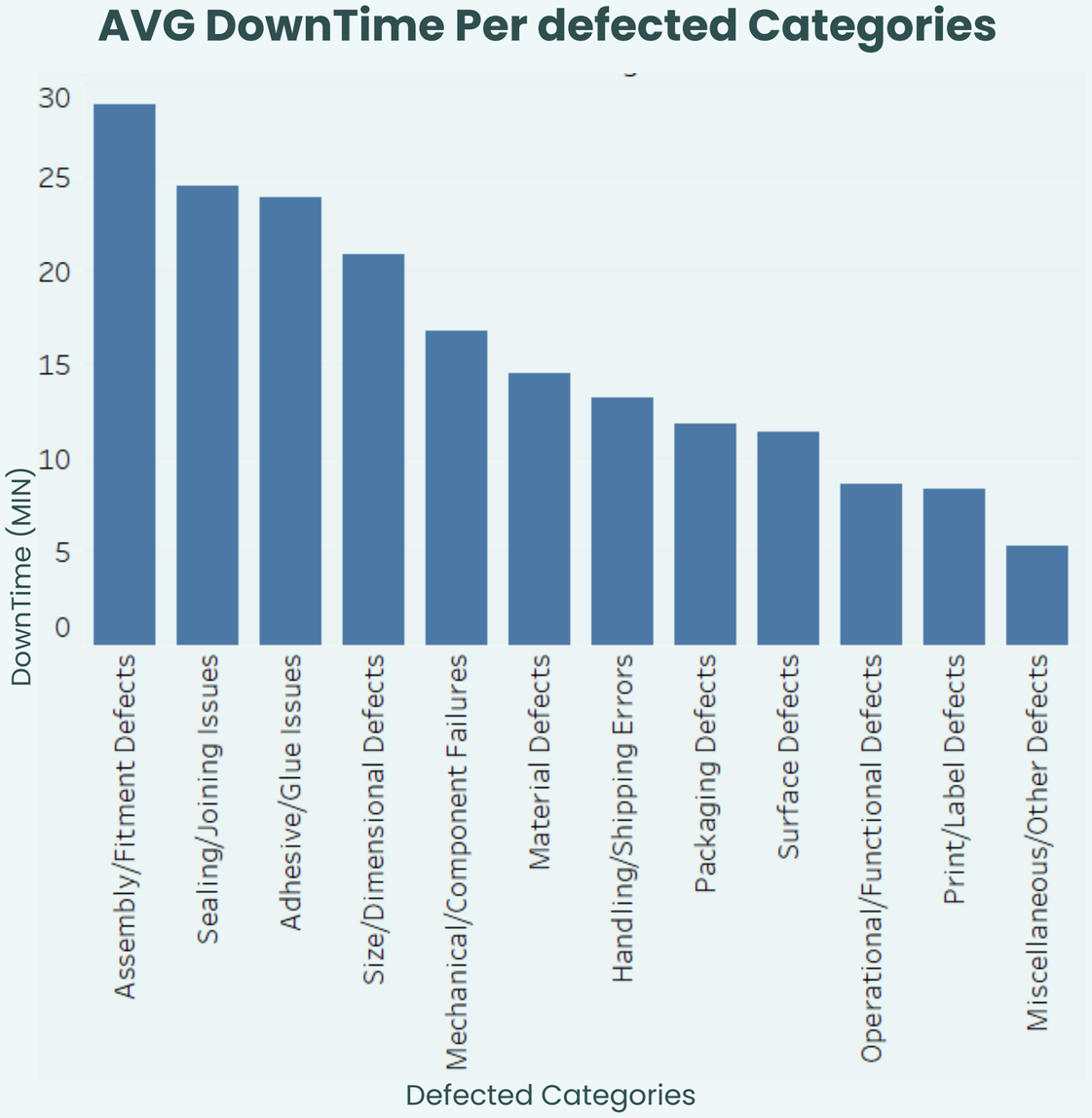
Defects

- The **Miscellaneous/Other** Defects category has the highest number of defective items, totaling 10 million.
- Conversely, the **Adhesive/Glue Issues** category has the lowest count, with only **366,000** defective items.



Defects

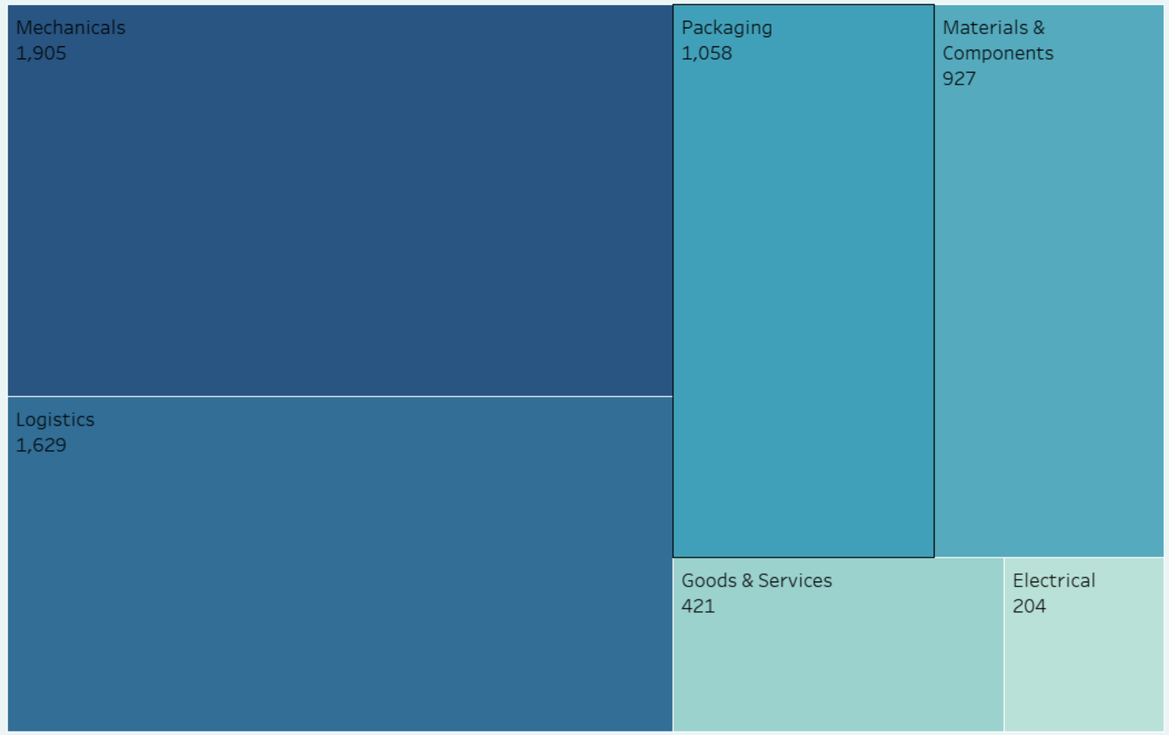
- While all defect categories exhibit similar proportions, **Assembly/Fitment Defects** still have the highest average downtime in minutes, indicating a greater impact on operations.



Category

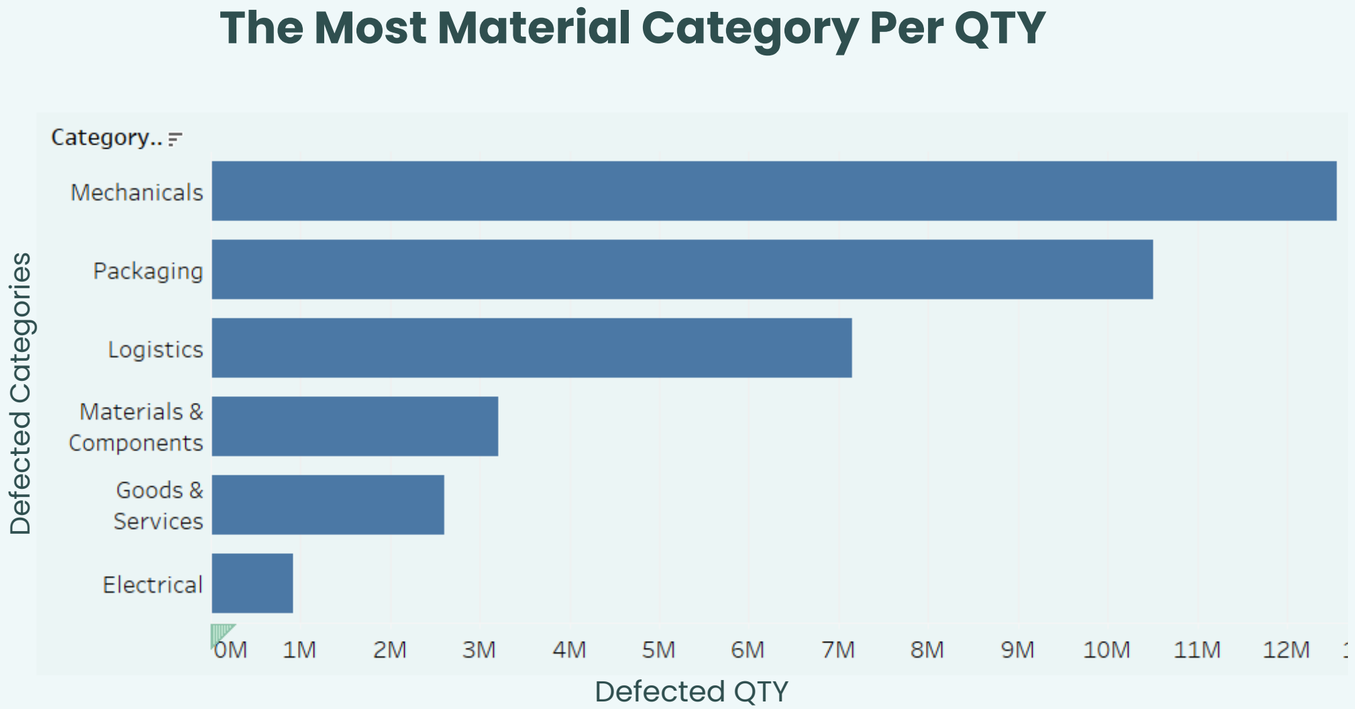
- The **Mechanical** category has the highest number of defective items, making it the most prevalent category.
- In contrast, the **Electrical** category has the fewest defective items, indicating it is the least problematic area.

Nom Of defected items by categry



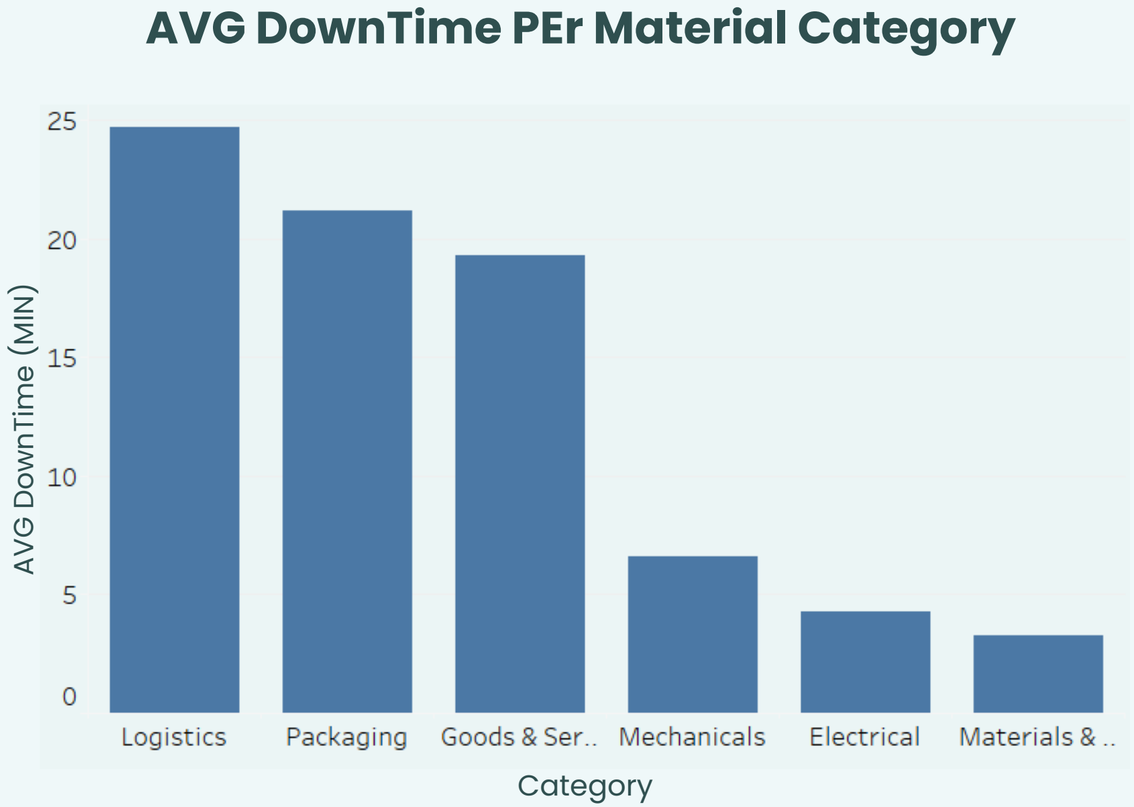
Category

- The data confirms that the **Mechanical** category not only has the highest quantity of defective items but also supports the conclusion that the **Electrical** category has the lowest quantity.



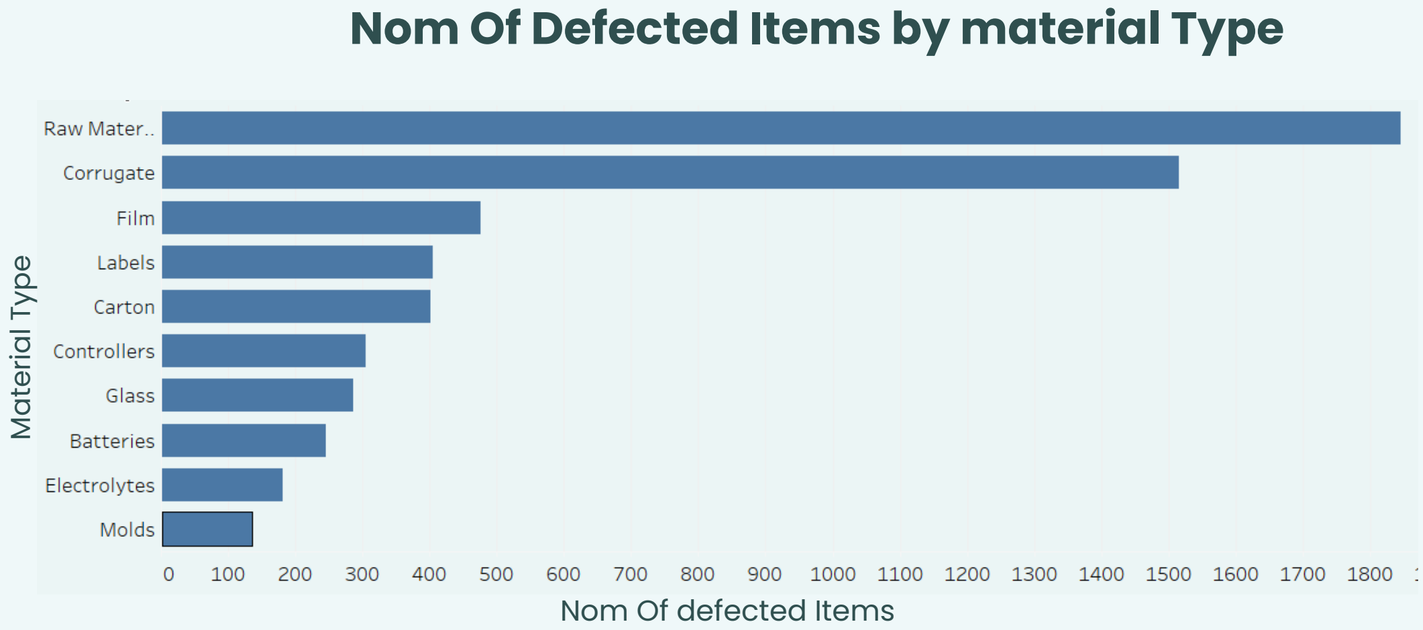
Category

- However, the chart indicates that the **Logistics** category experiences the highest average downtime in minutes among all material categories.



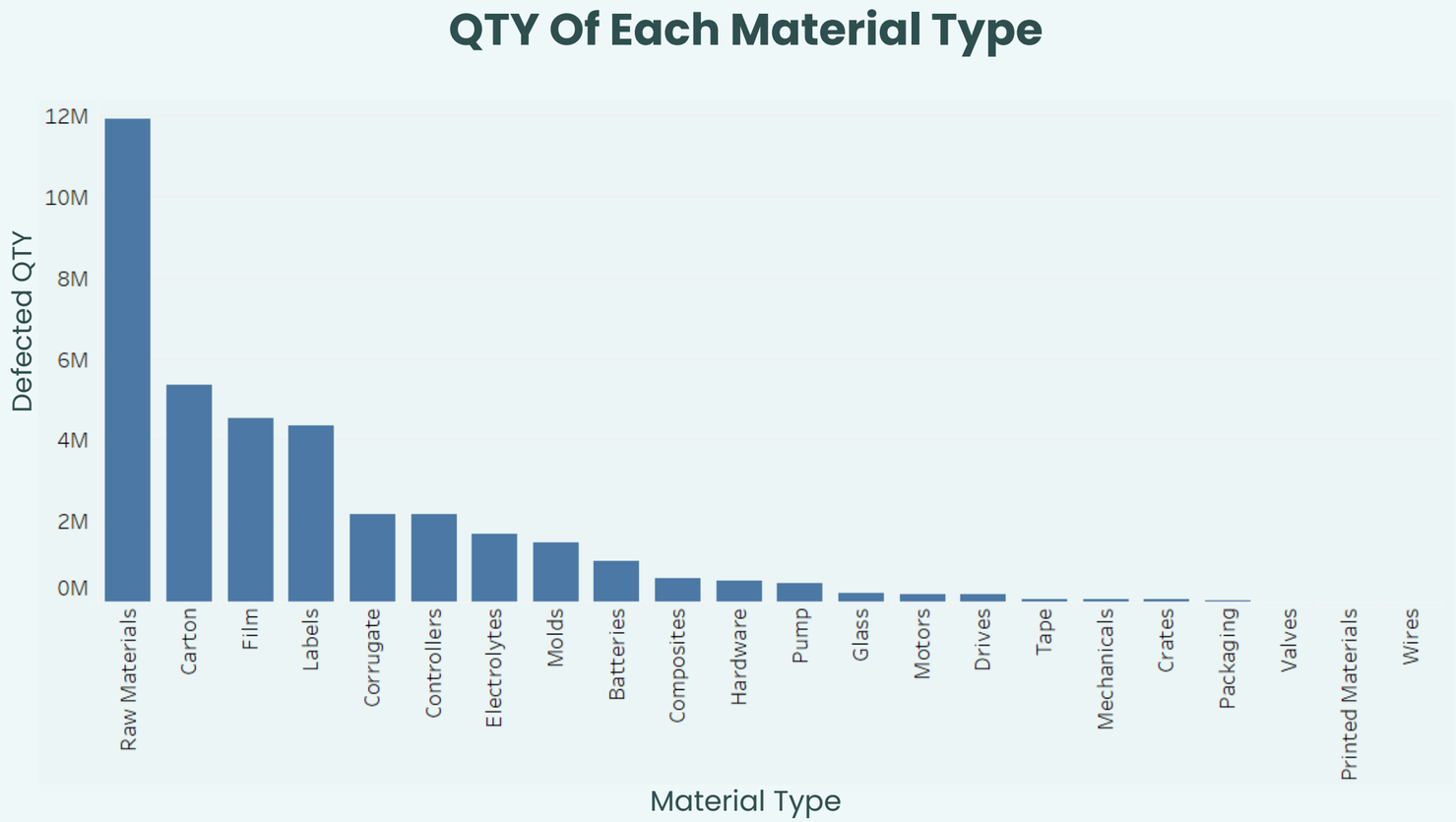
Material Type

- **Raw Materials** and **Corrugate** have the highest number of defective items, indicating significant issues in these categories.
- In contrast, **Electrolytes** and Molds have the fewest defective items, suggesting they are less problematic.



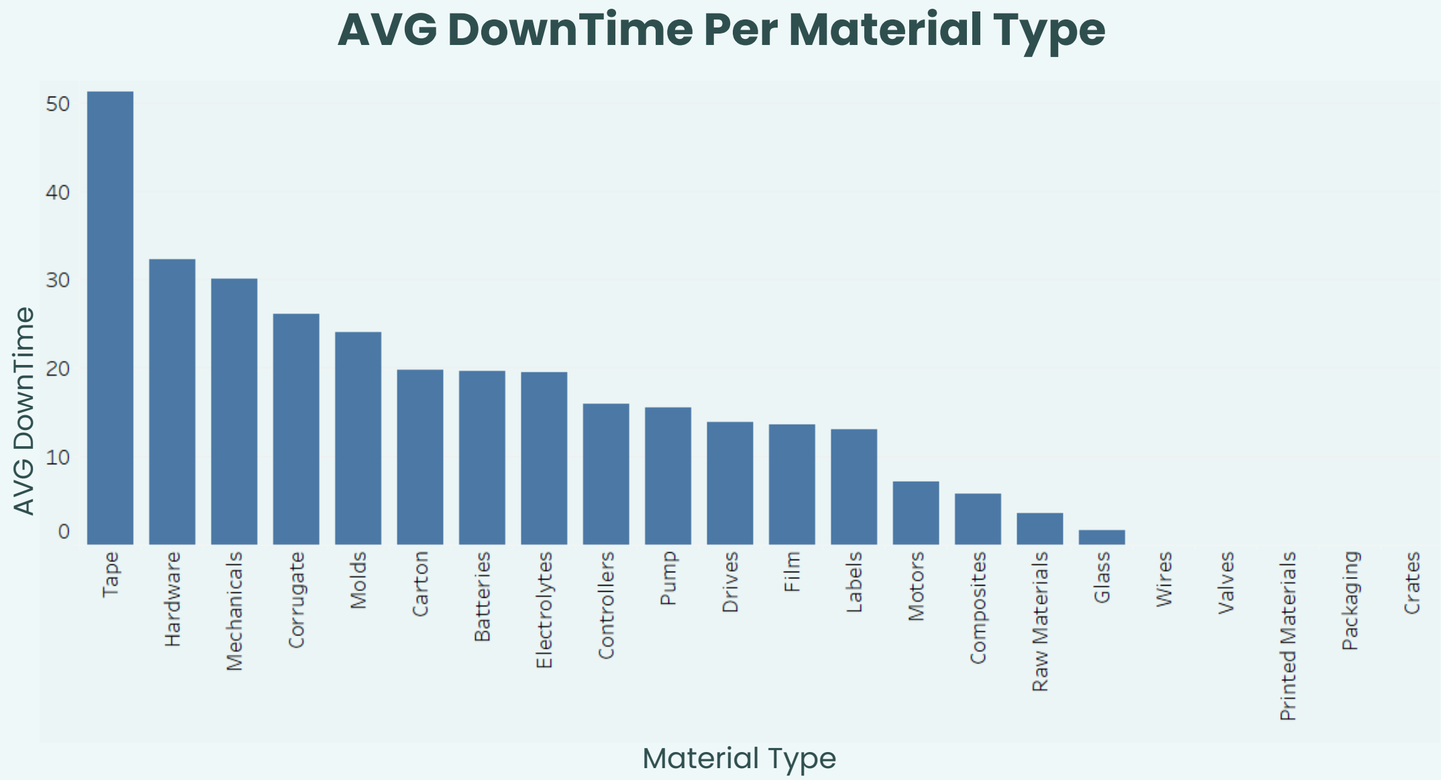
Material Type

- The chart confirms that **Raw Materials** have the highest quantity of defective items as well.
- Conversely, **Wires** have an exceptionally low quantity of defective items, nearly reaching zero.



Material Type

- The **Tape Type** category has the highest average downtime in minutes for items, indicating significant delays associated with it.
- In contrast, the **Crates Type** category has the lowest average downtime in minutes for items, suggesting minimal impact on operations.



Trends

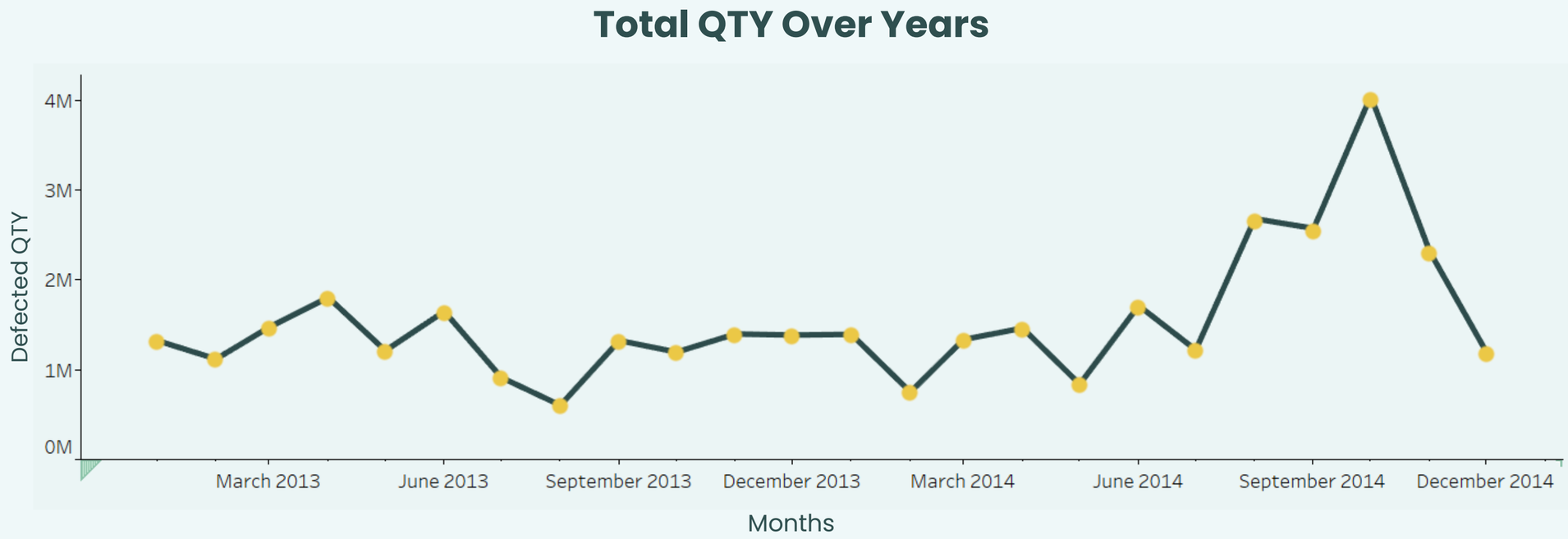
- **October 2014** marks the peak period, with the highest number of defective items, totaling approximately **555** items.
- Following this peak, there is a significant decline in the number of defective items until the end of December.

Trends

- The data reveals fluctuations between **2013** and **2014**, where the number of defective items experiences several rises and falls but generally trends upward leading up to the peak.

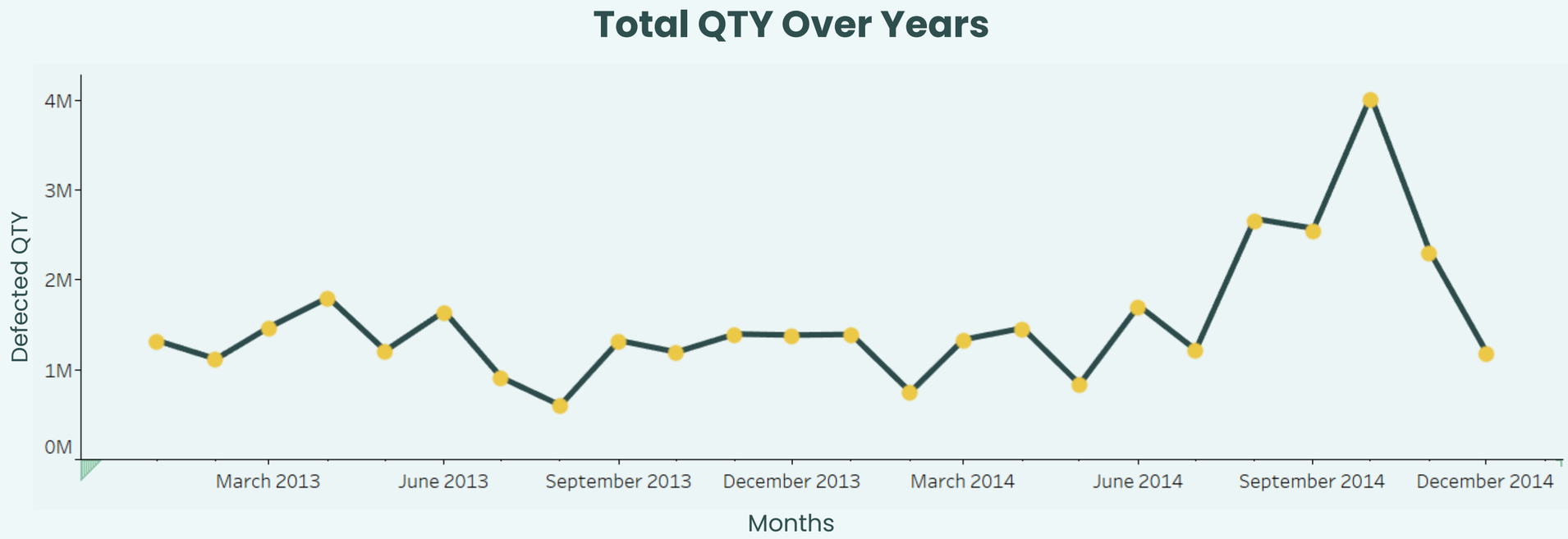
Trends

- There is a noticeable upward trend in defective quantities, especially as the chart progresses toward the latter months of **2014**.
- The highest defect quantity is recorded in **October 2014**, reaching **4,046,971** defective items.



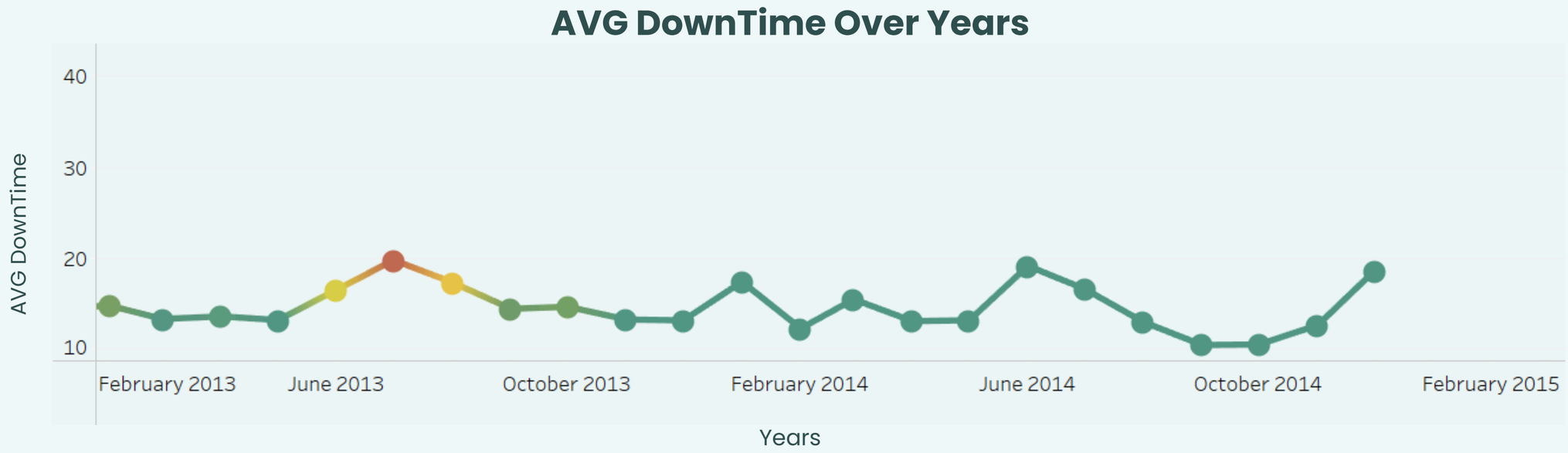
Trends

- Throughout **2013** and **2014**, the data shows significant fluctuations in the defective quantity, characterized by sharp rises and drops. The chart illustrates a cyclical pattern, but the overall volume of defects appears to increase as **2014** comes to a close.
- The lowest point occurs at the end of **2013**, specifically in **August**, with a value of **604,357** defective items.



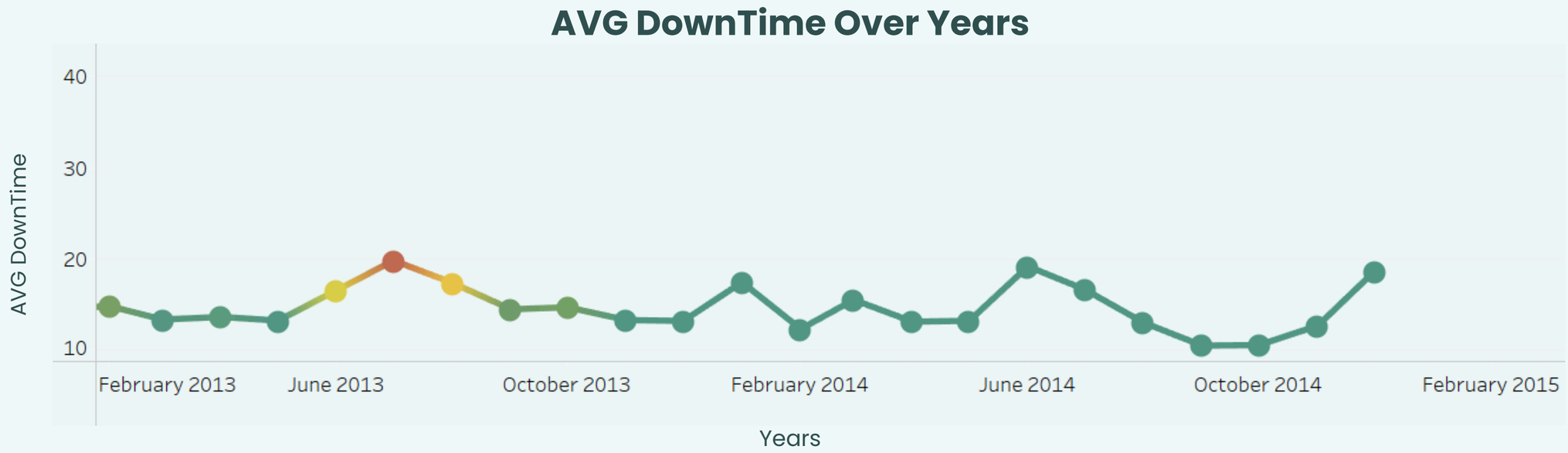
Trends

- The chart reveals a cyclical pattern of peaks and valleys in downtime, with no consistent upward or downward trend over the years. This indicates fluctuating issues with machine or process efficiency rather than a continuous improvement or decline.
- The peak downtime is recorded in **July 2013**, with an average of **19.83 minutes**, marking the highest downtime in the observed timeframe.



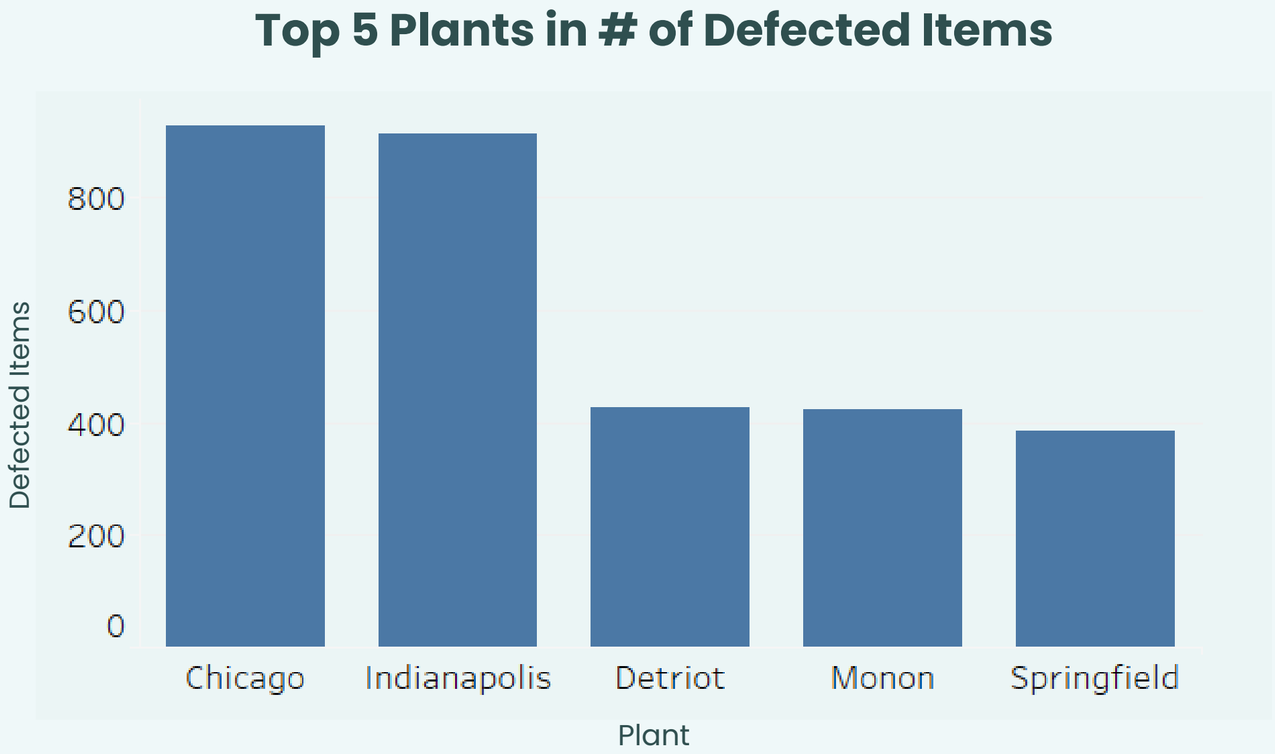
Trends

- Several months show a significant drop in average downtime, falling below **15 minutes**, particularly in **May 2013**, **December 2013**, **February 2014**, and **September 2014**.



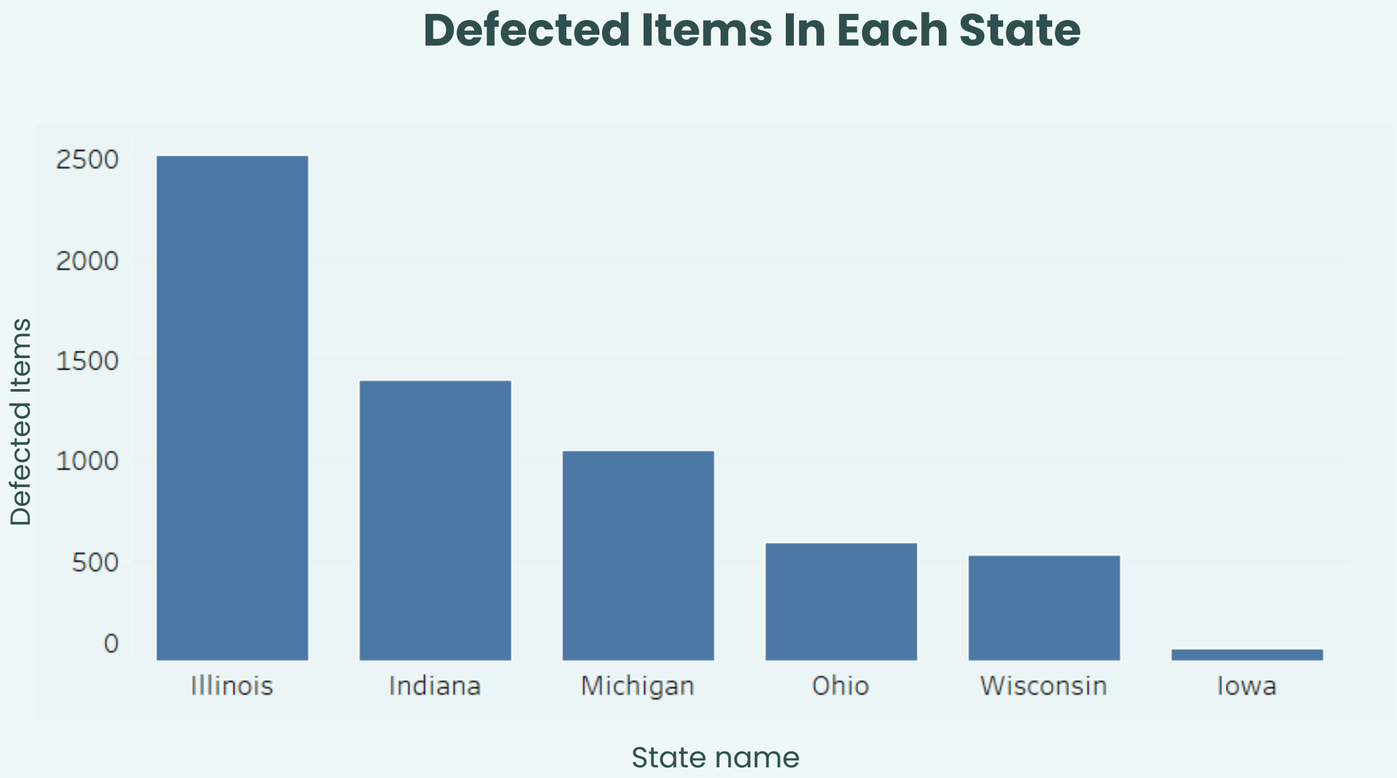
Plants

- The **Chicago** and **Indiana** plants have the highest number of defective items, with similar counts of approximately **900** each.
- In contrast, the **Monon** and **Spring** plants show significantly lower numbers of defects, each recording around **400** defective items.



Plants

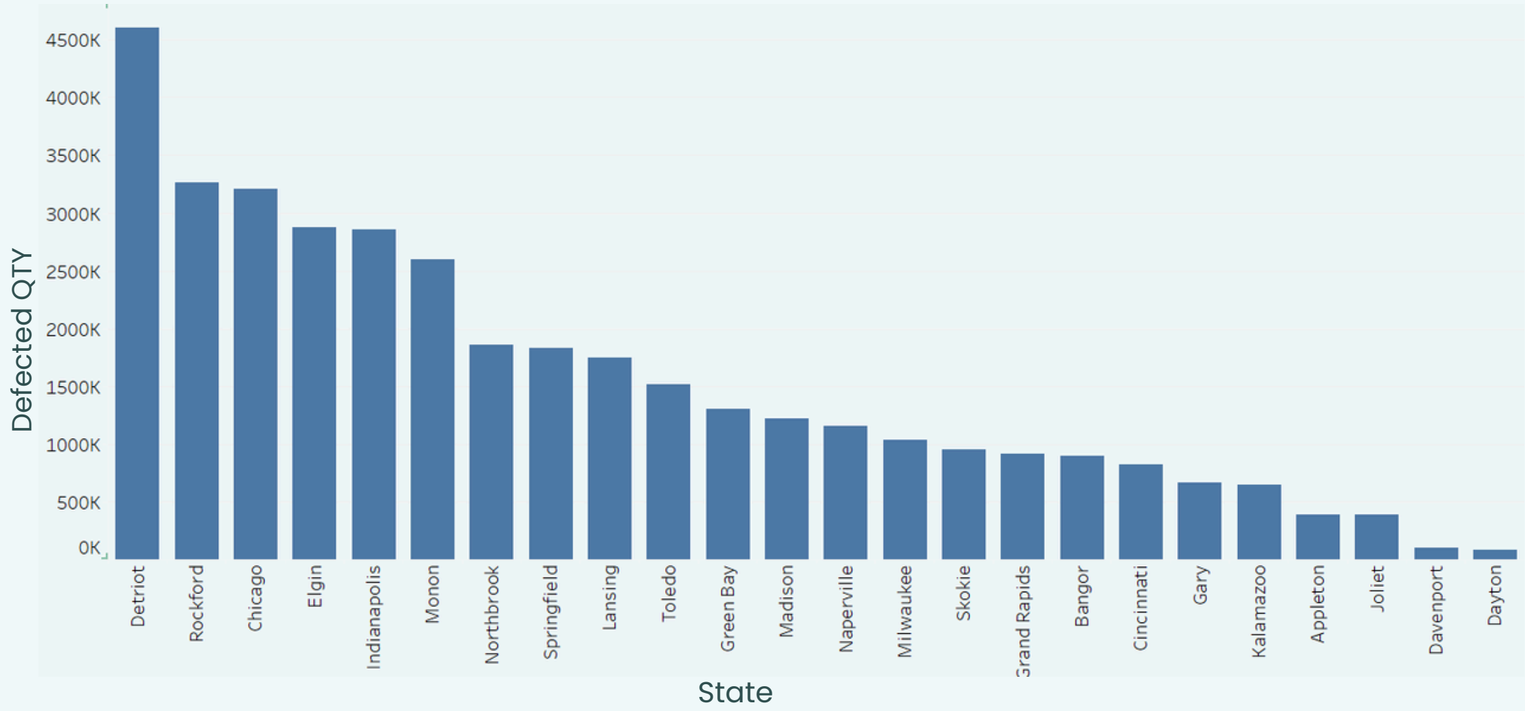
- **Illinois State** has the highest quantity of defective items, with similar counts of approximately **2,500**.
- Conversely, **Iowa State** exhibits significantly lower numbers of defects, with around **50** defective items.



Plants

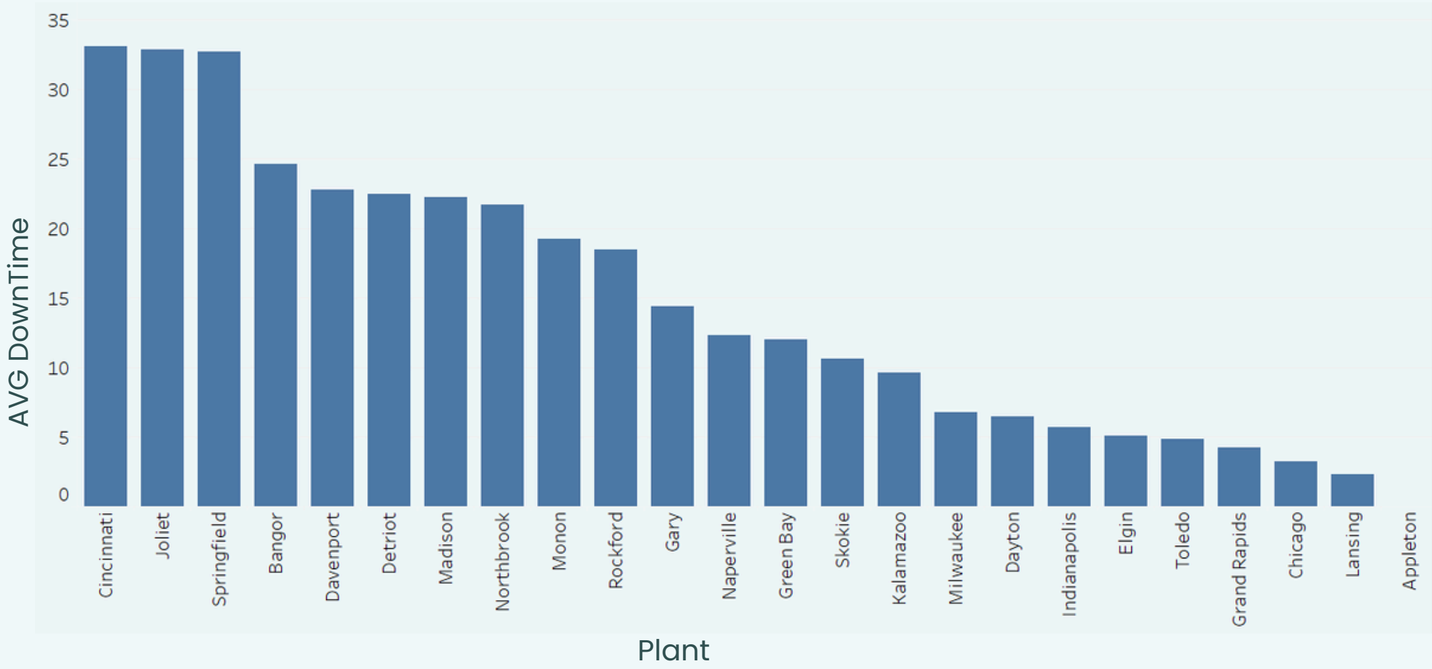
- **Detroit** stands out with a significantly higher quantity of defects, nearing **4.5 million** defective items, compared to all other plants.
- There is a gradual decrease in defect quantities among the remaining plants, with **Dayton** and **Davenport** showing the lowest numbers of defects.

Total QTY in each Plant



Plants

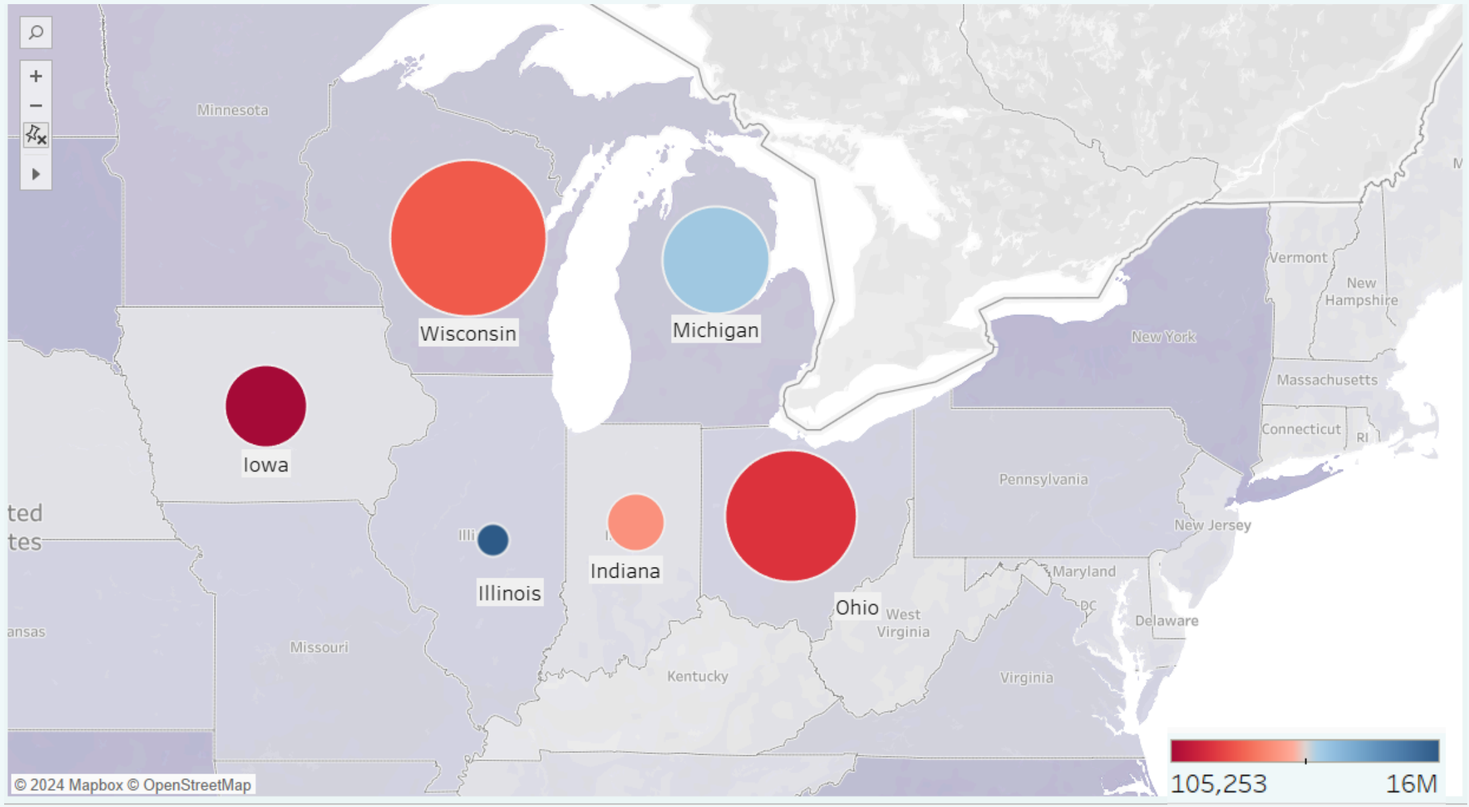
- **Cincinnati** has the highest average downtime, exceeding **33 minutes**, indicating significant operational issues or inefficiencies at this plant.
- In contrast, downtime decreases steadily across the remaining plants, with the Appleton plant reporting the least downtime, at nearly **0 minutes.**



Plants

- **Wisconsin** stands out with the highest quantity of defects, surpassing all other states by a significant margin.

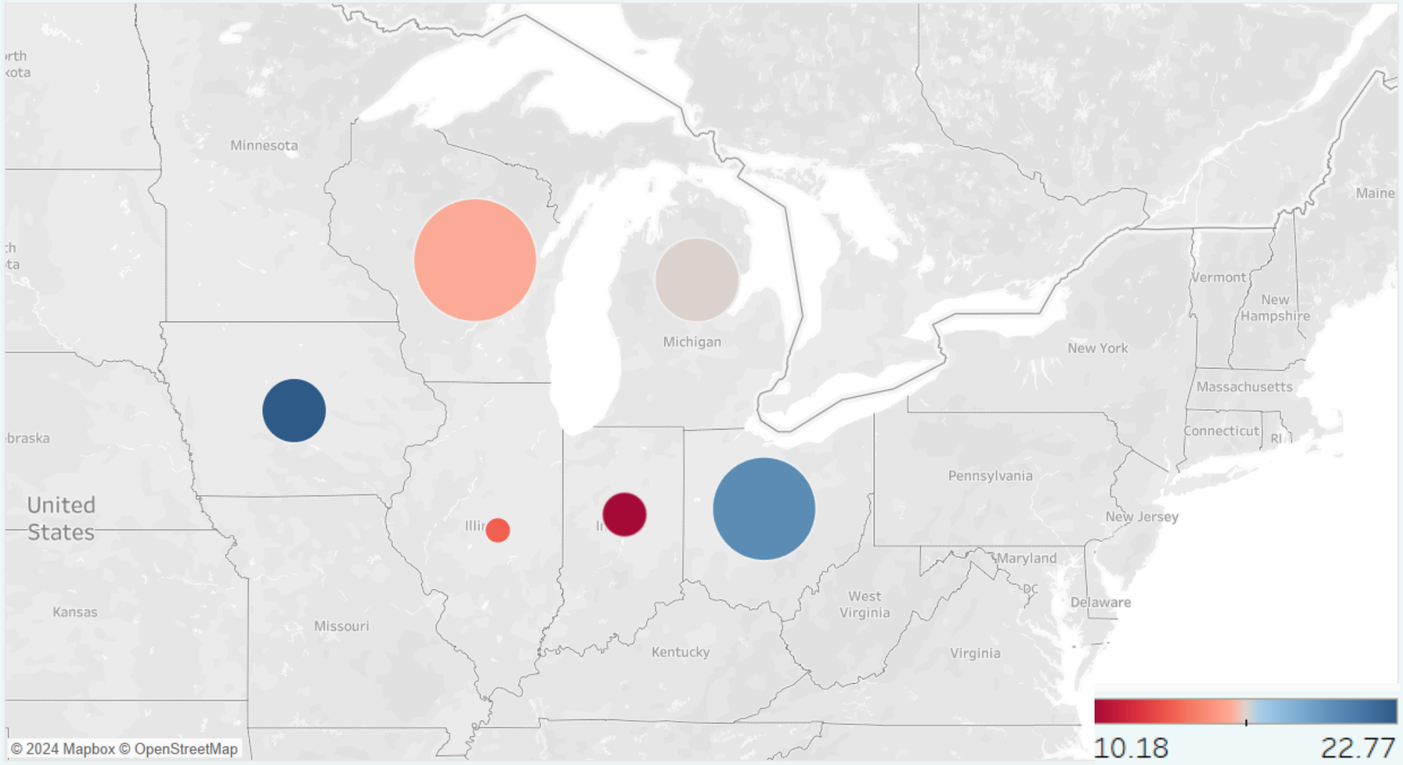
Total QTY Per Plants Geo



Plants

- **Iowa** has the highest average downtime, exceeding **22 minutes**, which indicates significant operational issues or inefficiencies in this state.
- Conversely, the downtime decreases steadily across the remaining states, with the **Indiana** plant recording the least downtime, at nearly **10 minutes.**

AVG DownTime In Each State



Key Findings

Vendors

Defects

Material Types

Defects Types

Plants

States

Material Categories

Over Time

Recommendations

What strategies can reduce defect rates and improve product quality?

1. Focus on reducing defects in raw materials that currently show no impact.
2. Target rejected defects in raw and corrugated materials to enhance quality and reduce costs.
3. Review sourcing and production processes to address defects in materials like film and labels.
4. Focus on improving quality control in plants like Chicago, Indiana, and Detroit with high defect rates.

What strategies can reduce defect rates and improve product quality?

5 Illinois needs more attention due to having the highest number of defective items across its plants.

6 Address high downtime at the Cincinnati plant to improve productivity.

7 Work closely with major vendors like Reddoit and Quotelane to reduce overall defect rates.

8 Investigate the spike in defects from October 2014 to identify potential production or quality control issues.


THANK
YOU!