Full Project & Presentation

DEFECTS ANALYSIS REPORT

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Agenda

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Executive Summary

Project Goal:

The primary goal of this project is to analyze defect trends across various materials and vendors, as well as their impact on downtime across different plants. The insights derived aim to optimize production quality and identify key areas for improvement.

Key Findings:

- Raw materials and film exhibit the highest defect quantities over the analysis period, with notable spikes in May and October.
- Specific vendors, such as Solholdings and Dentocity, have significant defect quantities, which contribute to downtime at plants.
- Defects categorized as “Miss” and “Not Verified” dominate the distribution.
- Certain plants like Detroit and Springfield exhibit higher defect quantities and downtime, pointing to operational inefficiencies.

Recommendations:

- Investigate the root causes of high defect rates in specific vendors and materials, particularly raw materials.
- Address process inefficiencies at high-defect plants, starting with the most affected ones.

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Introduction

Background:

- This analysis was initiated to understand trends in defect occurrences by material type, vendors, and plant locations. The primary goal is to reduce the defect rate, improve plant efficiency, and streamline vendor selection.

Problem Definition:

- High defect rates result in operational inefficiencies and prolonged downtimes at various manufacturing plants, leading to increased costs and reduced output quality.

Data Source and Methods:

- The data was collected from defect records spanning from January 1, 2013, to October 10, 2024.
- Tools used for analysis included Python for preprocessing and data cleaning, alongside dashboards built to visualize trends.

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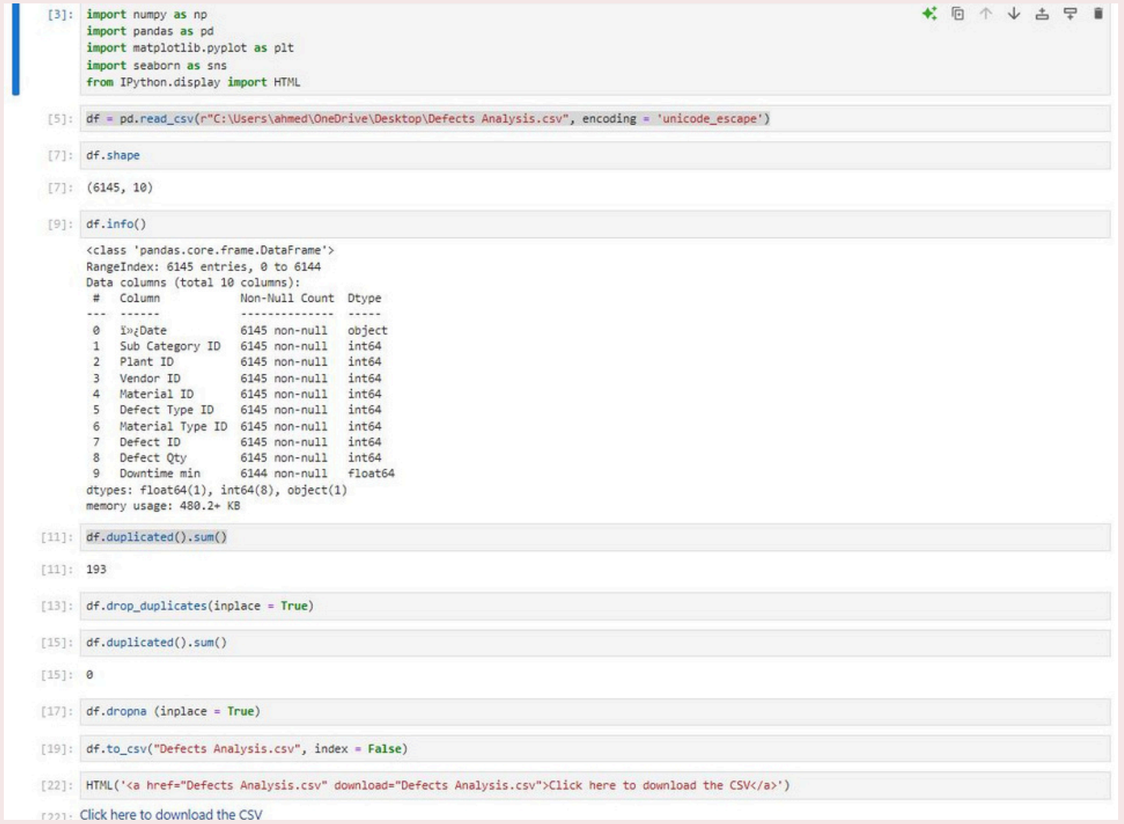
Data Exploration

- **Data Characteristics:**
  - The dataset consists of 6145 rows, each representing a defect occurrence. Key columns include Date, Material Type, Vendor ID, Defect Type, Defect Qty, and Downtime (in minutes).
  - There were 193 duplicated records, which were removed before analysis. Missing values were also handled

.

- **Summary Visualizations:**
  - Boxplot for Monthly Defect Trends by Material shows that raw materials have a wide range of defect occurrences.
  - Line chart for Monthly Defect Trends highlights notable peaks in May and October.
  - Bar charts and pie charts represent vendor performance and material-specific defect breakdowns.
  - Data Cleaning: Duplicated rows were removed, and null values in critical columns were filled or dropped.



```
[3]: import numpy as np
     import pandas as pd
     import matplotlib.pyplot as plt
     import seaborn as sns
     from IPython.display import HTML

[5]: df = pd.read_csv(r"C:\Users\ahmed\OneDrive\Desktop\Defects Analysis.csv", encoding = 'unicode_escape')

[7]: df.shape

[7]: (6145, 10)

[9]: df.info()

     <class 'pandas.core.frame.DataFrame'>
     RangeIndex: 6145 entries, 0 to 6144
     Data columns (total 10 columns):
      #   Column            Non-Null Count  Dtype
     ---  ------            --------------  -----
      0   ï»¿Date          6145 non-null   object
      1   Sub Category ID   6145 non-null   int64
      2   Plant ID          6145 non-null   int64
      3   Vendor ID         6145 non-null   int64
      4   Material ID       6145 non-null   int64
      5   Defect Type ID    6145 non-null   int64
      6   Material Type ID  6145 non-null   int64
      7   Defect ID         6145 non-null   int64
      8   Defect Qty        6145 non-null   int64
      9   Downtime min      6144 non-null   float64
     dtypes: float64(1), int64(8), object(1)
     memory usage: 480.2+ KB

[11]: df.duplicated().sum()

[11]: 193

[13]: df.drop_duplicates(inplace = True)

[15]: df.duplicated().sum()

[15]: 0

[17]: df.dropna (inplace = True)

[19]: df.to_csv("Defects Analysis.csv", index = False)

[22]: HTML('<a href="Defects Analysis.csv" download="Defects Analysis.csv">Click here to download the CSV</a>')

[22]: Click here to download the CSV
```

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Data Analysis

Key Findings:

- Defect Quantities by Material: The highest defects are found in raw materials, film, and cartons. These materials need immediate focus to improve the manufacturing process.
- Vendor Performance: Vendors such as Solholdings, Dentocity, and Plustax are responsible for the most defects, particularly in molds, labels, and film.

Downtime Analysis:

- Reddit and Plustax contribute the most to total downtime.

Plant Locations:

- The Detroit, Springfield, and Chicago plants show the highest defect rates and downtimes, indicating potential areas for operational improvements.

Interesting Discovery:

- A significant spike in defects and downtime was observed around May and October, which may be related to seasonal or batch-specific factors.

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Insights & Recommendations

- **Raw Materials and Film:** should be prioritized for improvement. These materials are consistently underperforming.
- **Vendor Optimization:** A review of top defect-causing vendors (Solholdings, Dentocity) should be conducted, focusing on renegotiating contracts or enforcing stricter quality control.
- **Plant-Level Interventions:** Plants with the highest defect rates and downtime, such as Detroit and Springfield, need operational audits to uncover inefficiencies and areas for training.
- **Preventive Maintenance:** Implement predictive maintenance strategies based on defect trends to minimize downtime and improve throughput.

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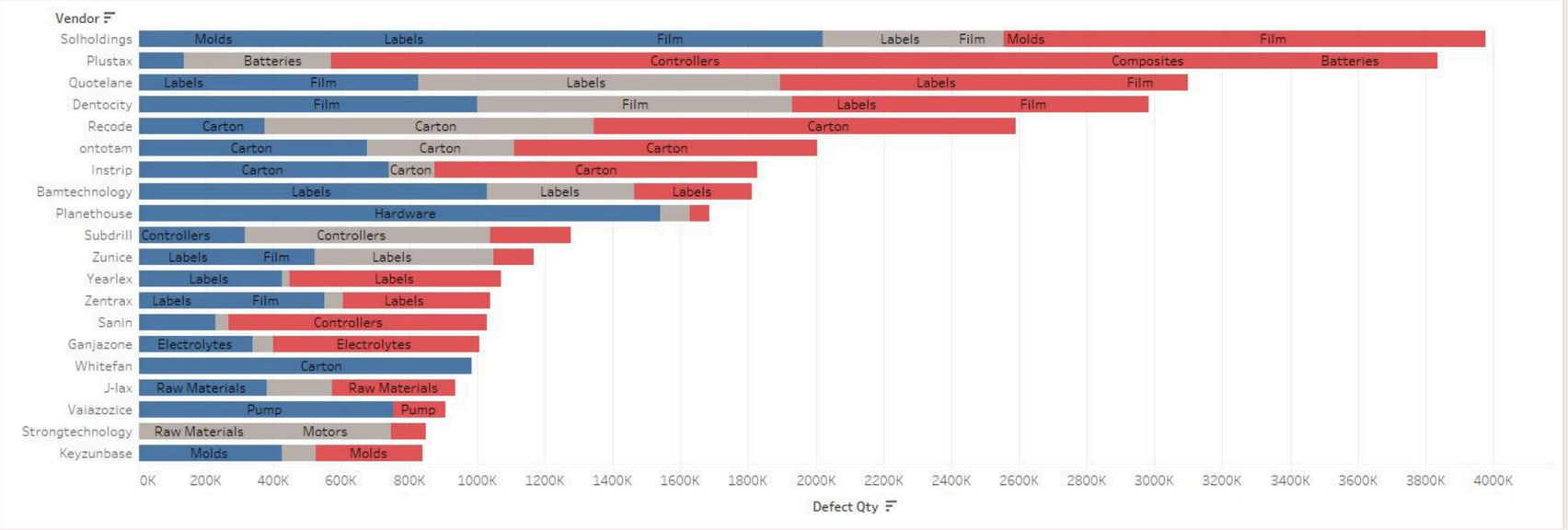
EDA Questions & Answers

1. Top Defects by Vendor

- **Question:** Which materials are most frequently associated with defects for different vendors?
- **Answer:** Vendors like Solholdings and Quotelane show a high number of defects associated with Labels and Film, while Plustax and Sanin have frequent defects in Controllers and Batteries, respectively.
- **Recommendation:** Implement stricter quality control for these materials and consider alternate vendors with better performance for Labels, Film, Controllers, and Batteries.



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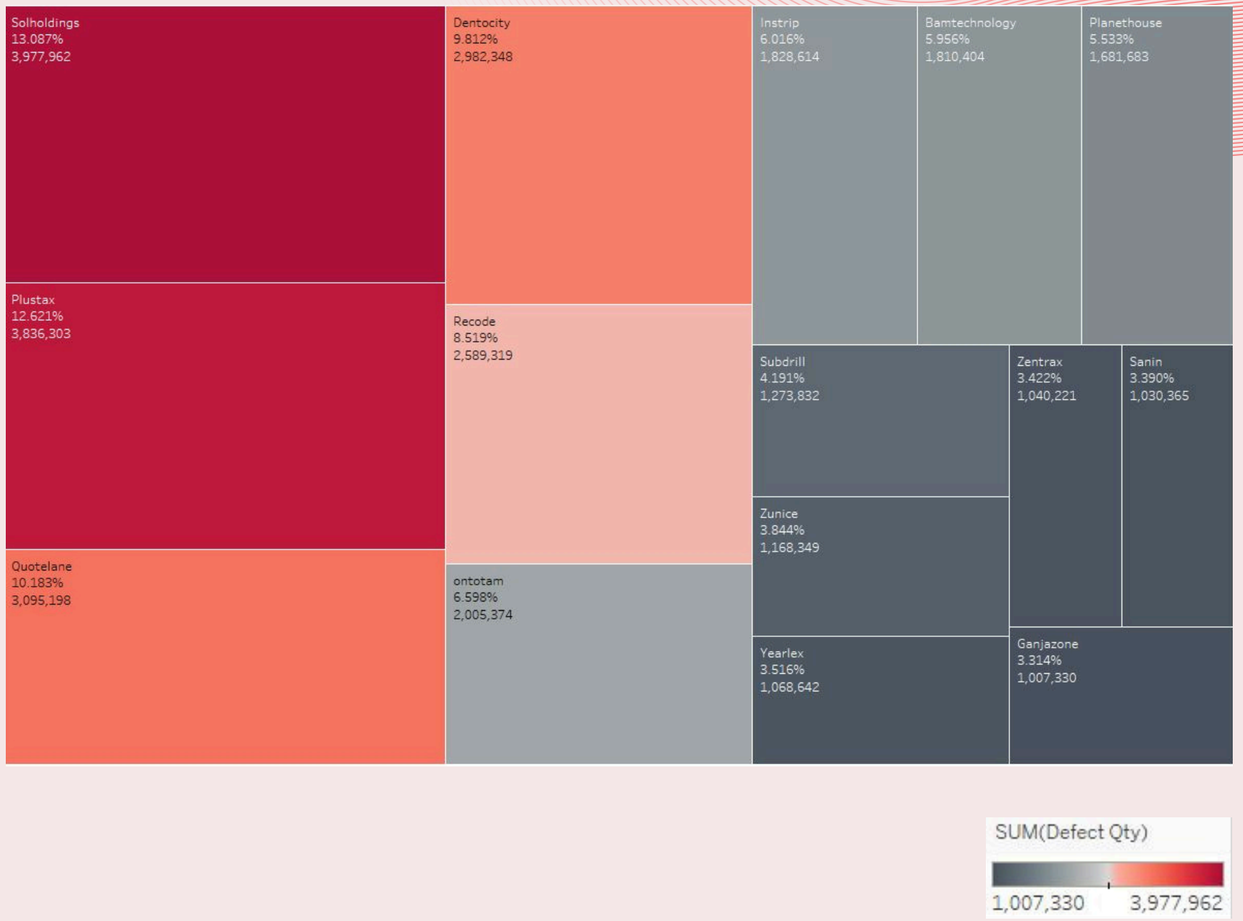
EDA Questions & Answers

2. Vendor Benchmarking (Defect Rate by Vendor)

Question:
Which vendor has the highest overall defect rate?

Answer:
Solholdings leads with the highest overall defect rate, with almost 4 million defects, followed closely by Plustax and Dentocity.

Recommendation:
Collaborate with these vendors on improvement plans and consider reducing material purchases until defect rates improve.



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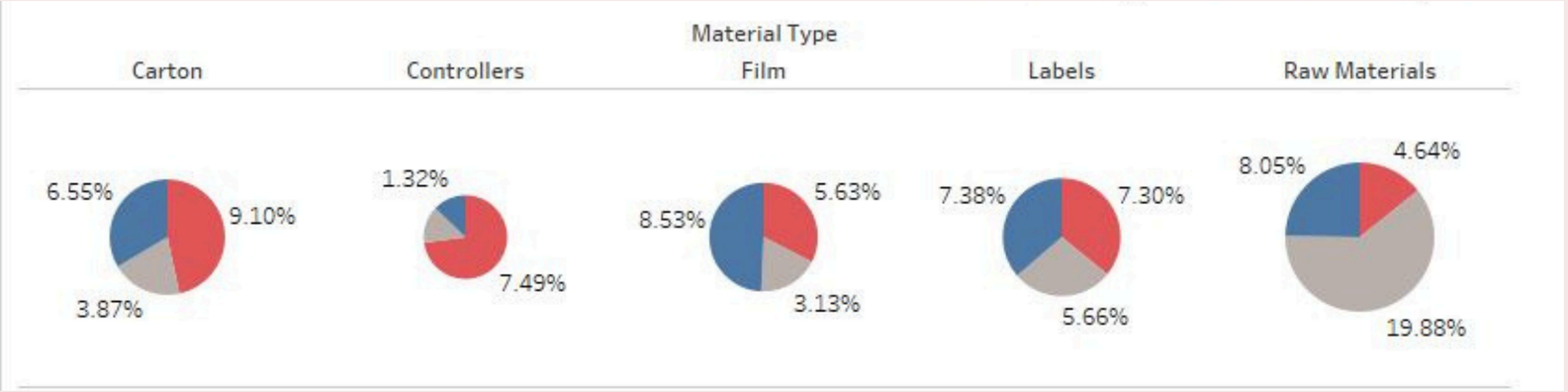
EDA Questions & Answers

3. Defect Type Breakdown by Material

- **Question:** What defect type is most common across different materials?
- **Answer:** Impact defects are the most common across multiple materials like Carton and Film, making up the largest proportion of defects when compared to No Impact and Rejected types.
- **Recommendation:** Review transportation and handling practices to reduce impact-related defects, focusing on improving packaging and handling standards.



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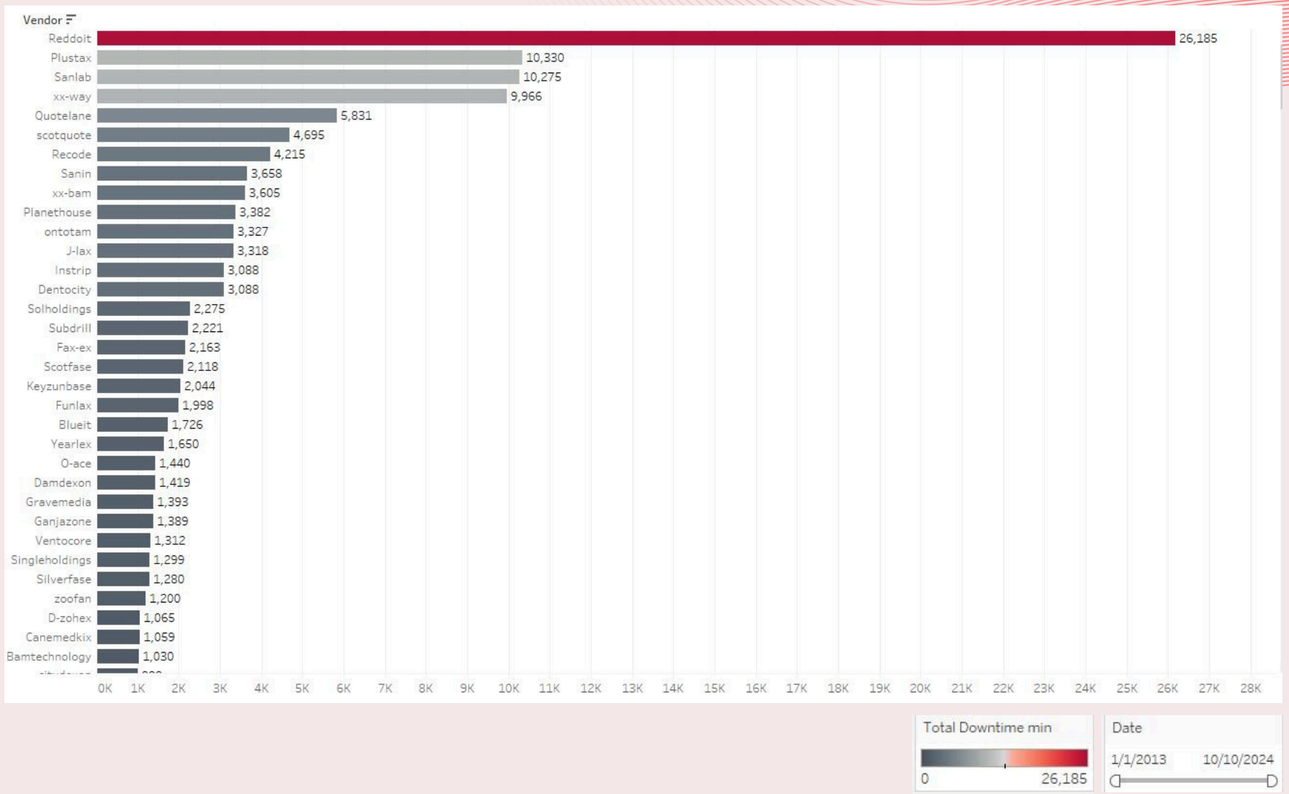
EDA Questions & Answers

4. Downtime Analysis (Total Downtime by Vendor)

Question: Which vendor has caused the most downtime due to defects?

Answer: Reddit has caused the most downtime, with a total of 26,185 minutes, significantly higher than the next highest vendor, Plustax, which had 10,330 minutes
of downtime.

Recommendation: Address defect sources with Reddit and consider implementing SLAs or having backup vendors to reduce downtime.



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EDA Questions & Answers

5. Defects by Plant Location

Question:
Which plant has the highest number of total defects, and how are they distributed by defect type?

Answer:
The Detroit, MI plant has the highest total defects, with 6,578,598 defects. Impact defects account for 2,078,940, while Rejected defects are the largest at 3,559,494.

Recommendation:
Conduct a detailed audit of the Detroit plant and implement process improvements and retraining to reduce rejected defects.

	Defect Type		
Plant	Impact	No Impact	Rejected
Detriot, MI	2,078,940	971,643	3,559,494
Springfield, IL	3,369,963	329,907	84,135
Northbrook, IL	718,384	166,375	2,855,443
Chicago, IL	814,334	1,805,811	1,094,444
Rockford, IL	1,570,914	478,318	1,647,901
Indianapolis, IN	412,035	2,361,369	658,105
Monon, IN	1,663,222	305,362	1,388,280
Elgin, IL	227,598	1,997,773	774,668
Naperville, IL	1,068,222	188,602	954,673
Milwaukee, Wi	134,103	1,083,537	785,520
Skokie, IL	1,258,024	291,823	418,318
Toledo, OH	401,098	969,311	567,997
Madison, WI	1,448,417	227,583	228,438
Kalamazoo, MI	462,711	1,264,154	166,488
Bangor, MI	1,267,338	357,803	148,100
Grand Rapids, MI	37,631	474,007	1,138,442
Lansing, MI	34,594	1,350,740	245,863
Green Bay, WI	329,743	689,470	610,184
Gary, IN	950,377	296,973	249,656
Cincinnati OH	829,332	174,982	205,482
Appleton, WI			997,961
Joliet, IL	143,023	77,189	440,031
Dayton, OH	26,558	27	105,020
Davenport, IA	55,001	5,546	44,706

Total Defect Qty
27 3,559,494

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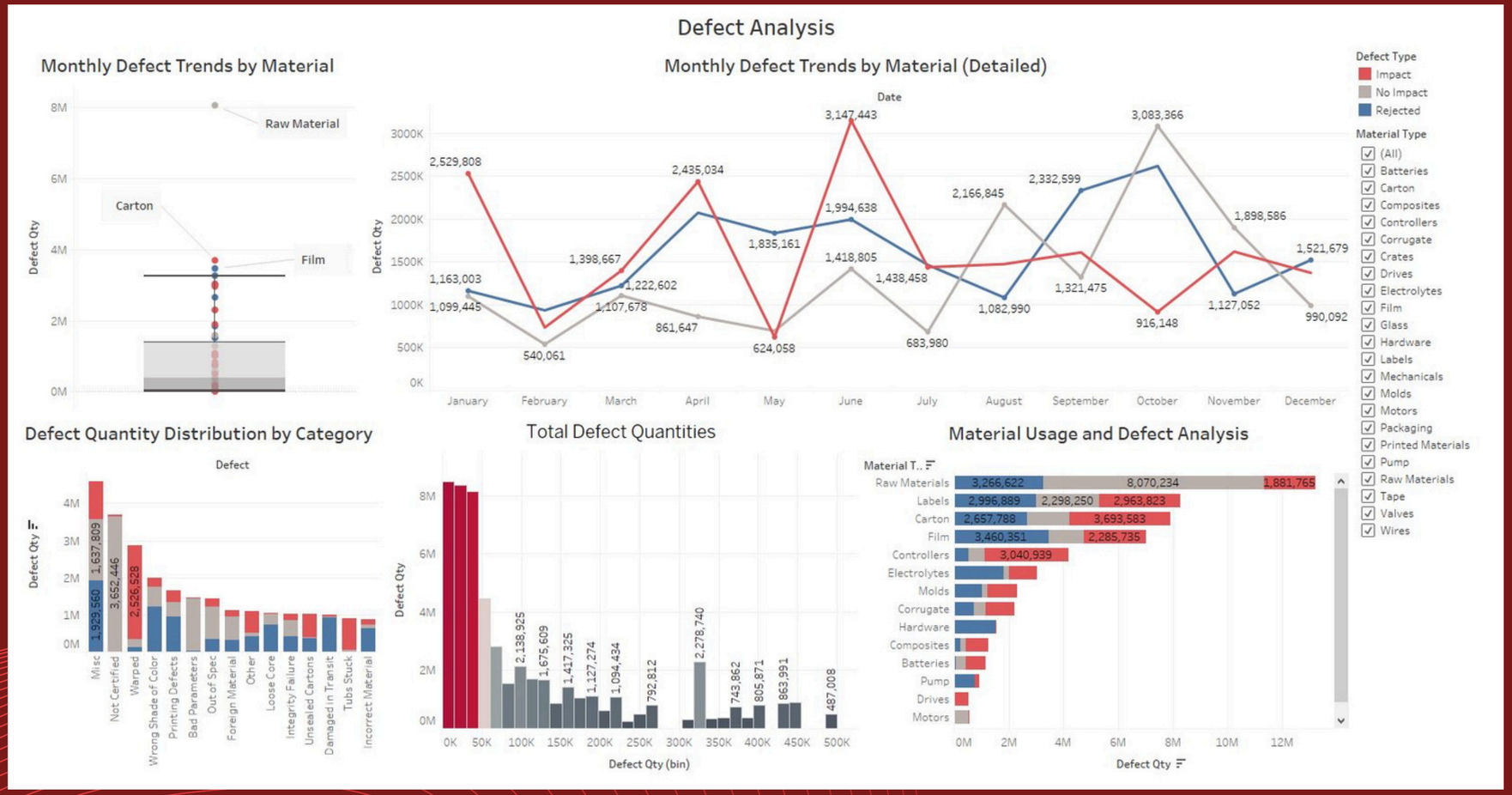
Dashboards



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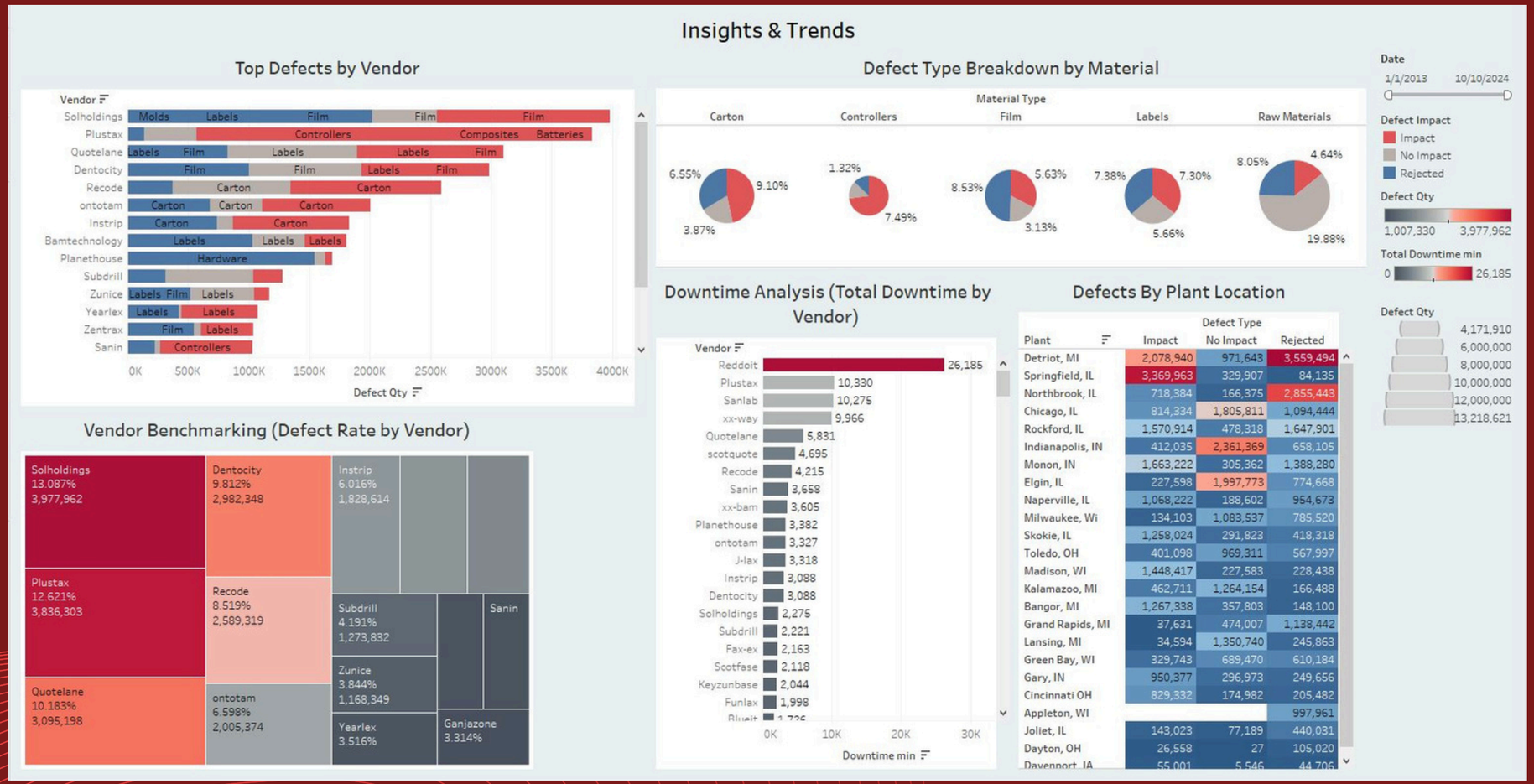
Dashboards



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Limitations and Future Work

Limitations: The analysis relies on available defect data, and potential external factors like supply chain disruptions or operator errors may not be fully captured.

Future Work: Future studies can focus on correlating these defect trends with external factors such as supply chain reliability or seasonality to uncover deeper insights. More granular analysis at the vendor or machine level could also be conducted.

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Conclusion

- Raw materials and film have the highest defect rates.
- Vendors like Solholdings and Dentocity contribute significantly to downtime.
- Detroit and Springfield plants show notable operational inefficiencies.
- Key focus areas: improve material quality, optimize vendor performance, and audit high-defect plants to reduce downtime and boost productivity.

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THANK YOU FOR YOUR TIME!