Identifying Inventory Scrap Reduction Opportunities

ISYE 492 Senior Design Project
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ThermoFisher SCIENTIFIC

Inside Thermo Fisher: A Closer Look

❖ Thermo Fisher is a top supplier of scientific instruments, reagents, consumables, and software services

❖ Thermo Fisher manages a vast and ever-expanding product portfolio

❖ Thermo Fisher offers tens of millions of unique SKUs

❖ Large production batches are generated due to high demand for SKUs from customers

❖ Thermo Fisher employs automated and manual methods to collect and store historical data

Microplates   Organic and Inorganic Acid Products   High-Speed Centrifuge Tubes   Refrigerated Bath

Why Our Initial Approaches Fell Short

❖ Finding commonalities in a scrapped SKU was difficult due to high variance in scrap quantity, types of SKUs, reasoning, and other variables over time

❖ Our first strategies didn't account for a scraps quantity being relative to its usage

❖ Despite being able to identify highly scrapped items, their scrap value was very low

❖ A SKU can be multiple variants of the same variable such as WXYZ

❖ Overlap in reasons for scrap, such as Forecasting and Overbought, further complicated analysis

The Overlooked Cost & Impact of Scrap

❖ Thermo Fisher faces a significant challenge: high customer demand leads to massive scrap, costing tens of millions annually. Our main objective is to identify opportunities to reduce scrap

❖ Scrap is diverse and can be defined through:

➢ Devaluation Costs: Value of items can fall quickly and steeply when held in inventory

➢ Obsolescence Costs: Inventory can lose its value when new products are introduced

➢ Defective Materials: Products can be scrapped due to defects in the materials used to make them

Fiscal Year	2018	2019	2020	2021	2022	2023
Value	$43M	$326M	$47M	$72M	$86M	$10M

First Glance: Scrap Value per Fiscal Year

Examples of Our Initial Strategies

Identifying Specific SKUs with High Scrap Values

SKU Number	Display Value	Scrap Quantity	Fiscal Year	Cause of Scrap	Branch Code
A33502	$282,622,673	2,188,112	2019	Null	US03
100103376	$ 1,669,466	70,000	2021	Null	LT01
A48105	$ 1,460,730	2,001	2022	Quality Issue	GB01

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Creating Tables and Ordering by Scrap Quantity

SKU Number	Display Value	Scrap Quantity	Fiscal Year	Cause of Scrap	Branch Code
MT36814	$ 0	199,605,000	2021	Overbought	US15
MT34080	$ 9990	99,898,341	2018	Overbought	US15
100094872	$ 333,555	66,300,000	2022	Misalignment	LT01

Examples of Our Initial Strategies

Relating Scrapped SKUs to a SKUs Usage to Determine Proportionality

Product Group	2018	2019	2020	2021	2022
1C7	$ 242,693	$ 180,820	$ 138,725	$ 174,794	$ 295,997
ANT	$ 1,106,337	$ 526,835	$ 633,667	$ 256,692	$ 1,172,656
FCR	$ 2,129,282	$ 1,593,957	$ 3,316,388	$ 1,593,147	$ 1,487,461

❖ Looked for Product Group Codes (a family of SKUs) scrapped consistently for 5 years

❖ FCR was chosen to analyze due to its consistently high scrap value

❖ The goal was to only pull SKUs from the usage data that were FCR coded SKUs present in scrap data

❖ Now that we had a scrapped SKUs usage, we could identify opportunities to lower a safety stock If a SKU had a high on hand inventory and scrap rate, but low usage

Examples of Our Initial Strategies

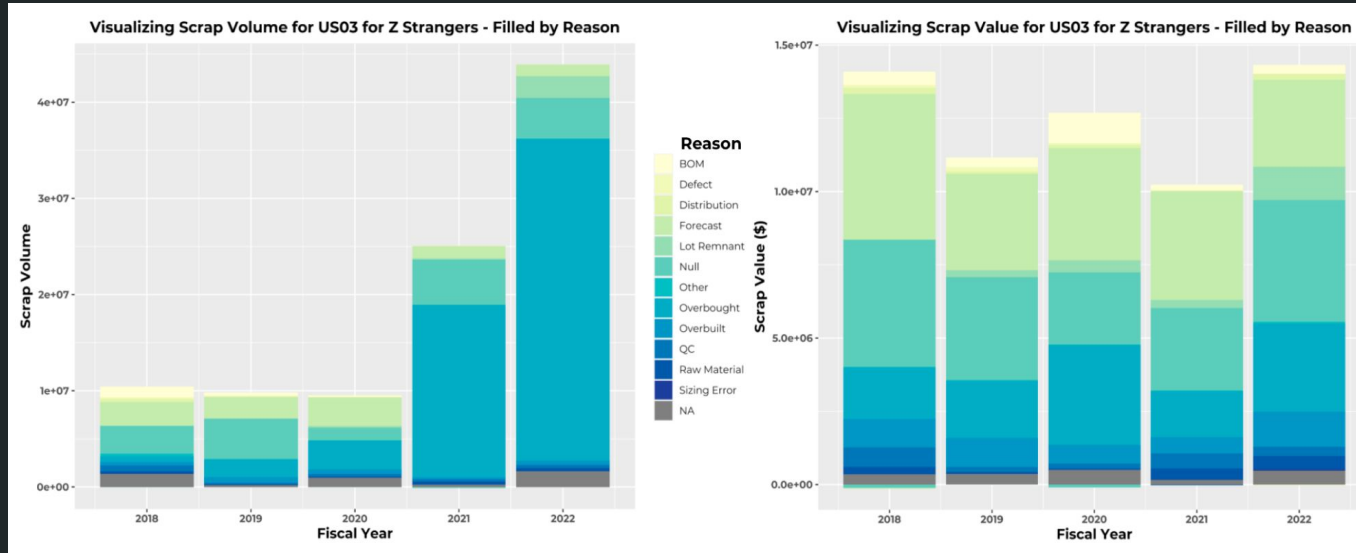**A Sequence of Examining Variables Over Time to Spot Trends**
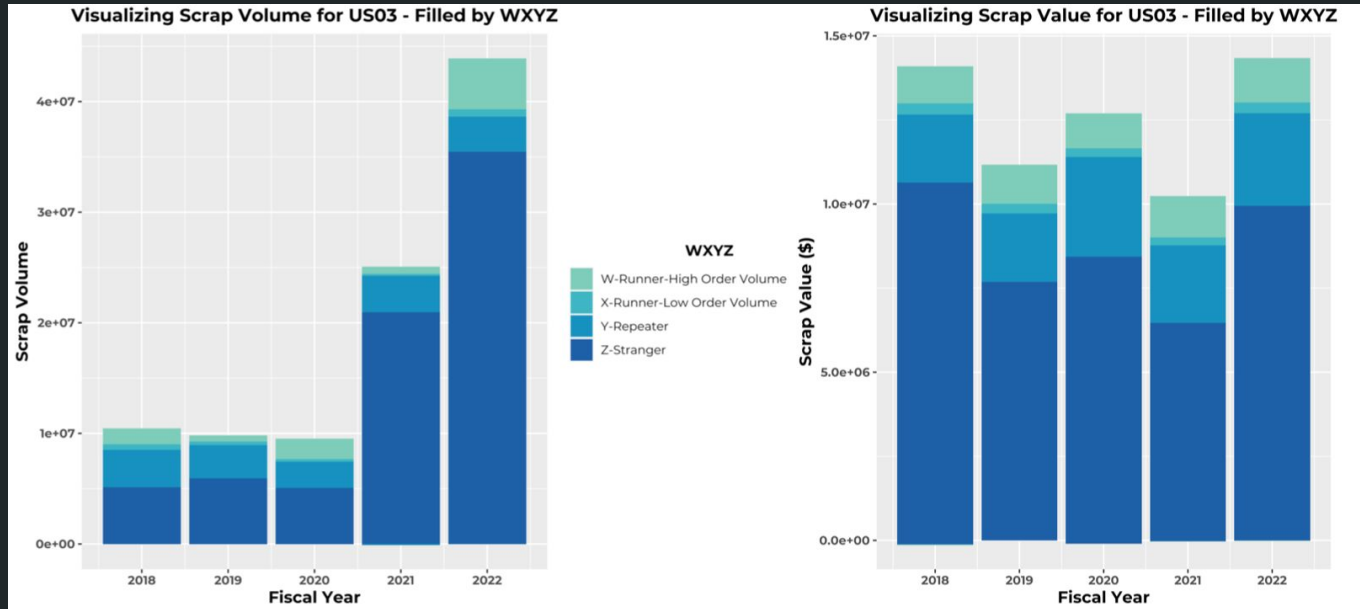
- ❖ WXYZ: A variable that represents a SKUs usage and order volume
- ❖ Since 2018, "Z-Strangers" scrap volume has increased by 30 million (left)
- ❖ From 2018 to 2022, the same Z-Stranger category has decreased in value (right)

Examples of Our Initial Strategies

A Sequence of Examining Variables Over Time to Spot Trends

- ❖ Reasons for scrap can vary - forecasting, quality issue, defect, and more

- ❖ Looking at Z-Strangers alone, overbought is the primary reason for scrap (left)

- ❖ However, overbought was not the cause for Z-Strangers to decrease in value

- ❖ The quantity of overbought scrap is not proportional to it scrap value (right)

Key Takeaways From Our Initial Approaches

❖ There is no single reason for high scrap values and quantities, are changes annually

❖ Although some SKUs are highly scrapped, their scrap values can be little to none

❖ 23% of scrapped SKUs had missing values (NAs) for the reasoning

Key Takeaways From Our Initial Approaches

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❖ The top 3 reasons for scrap value was Forecasting, NULL, and Overbought. Each display value over 30M and accounting for 61% of all scrap value

Reason	Value	Percentage Value	Percentage Quantity
Forecast	$ 107,198,744	35%	7%
Null	$ 41,319,387	14%	7%
Overbought	$ 36,043,700	12%	42%

Reasons for Top 3 Scrap Values From 2018-2023

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❖ The top 3 reasons for scrap quantity was Overbought, Raw Material, and Defects. Each quantity over 80M and accounting for 62% of all scrap quantity

Reason	Value	Percentage Value	Percentage Quantity
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Null	$ 41,319,387	14%	7%
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Reasons for Top 3 Scrap Values From 2018-2023

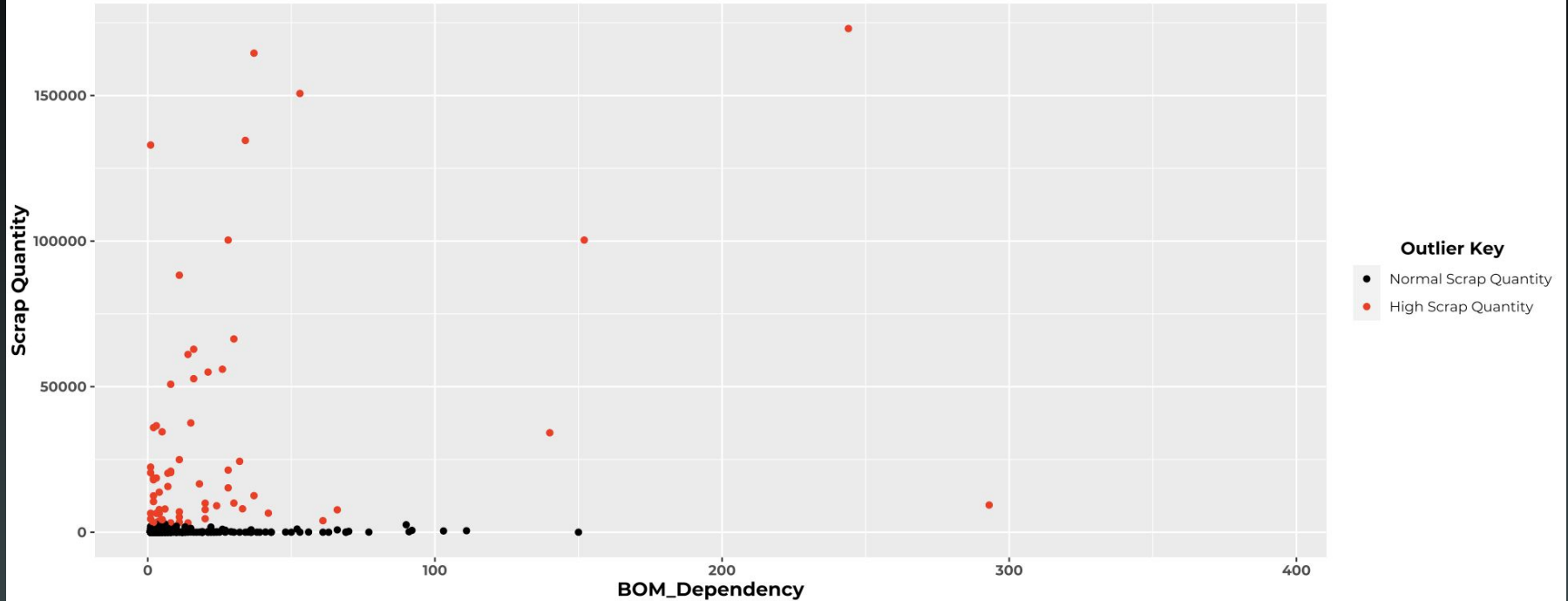| Reason	Quantity	Percentage Value	Percentage Quantity
Overbought	431,565,031	12%	42%
Raw Material	113,386,438	2%	11%
Defect	88,860,208	5%	9%

Reasons for Top 3 Scrap Quantities From 2018-2023

Rethinking Our Plan: Navigating the Complexity of Scrap Using Clustering

❖ Utilized k-means clustering to create a "Priority List" of SKUs to focus on

❖ Hypothesis: SKUs belonging to the same cluster, should behave similarly and therefore have similar amounts of scrap

❖ Variables used to cluster the SKUs include:

➢ Branch Code

➢ WXYZ

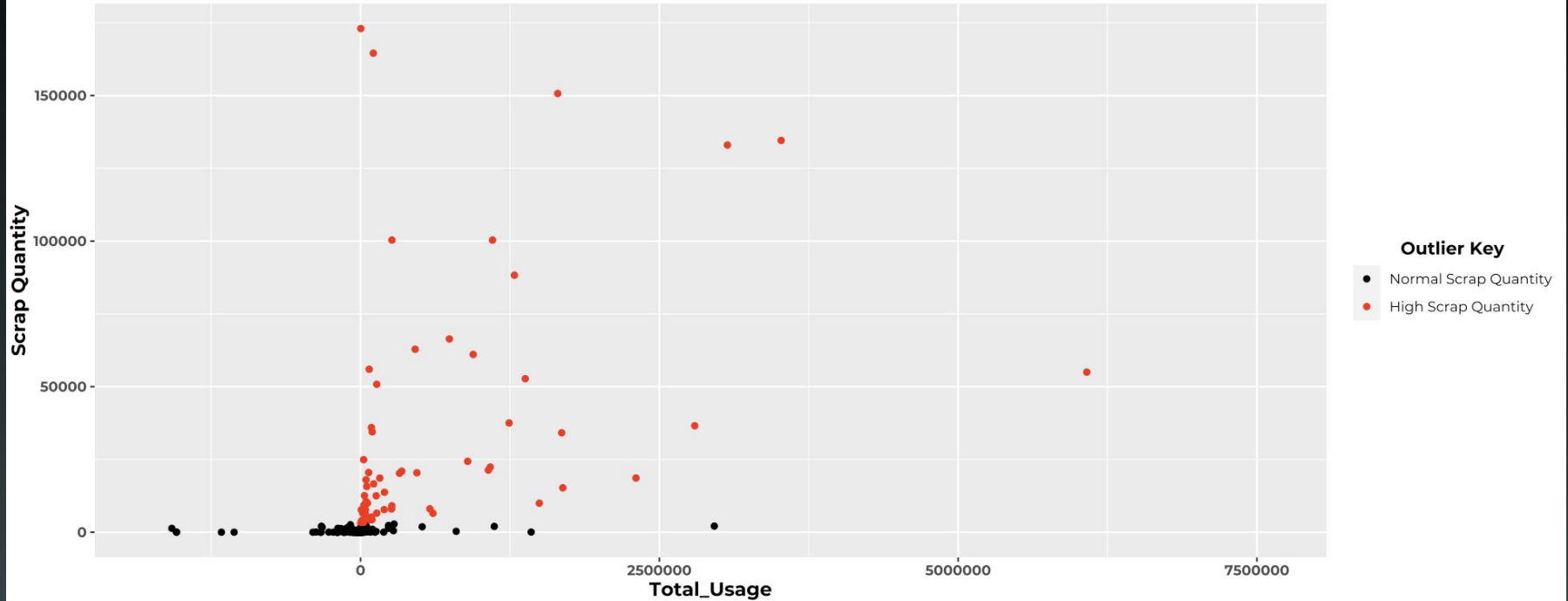➢ Sales Rank Code

➢ BOM Dependency

➢ Usage of previous year

Clustering Outcomes

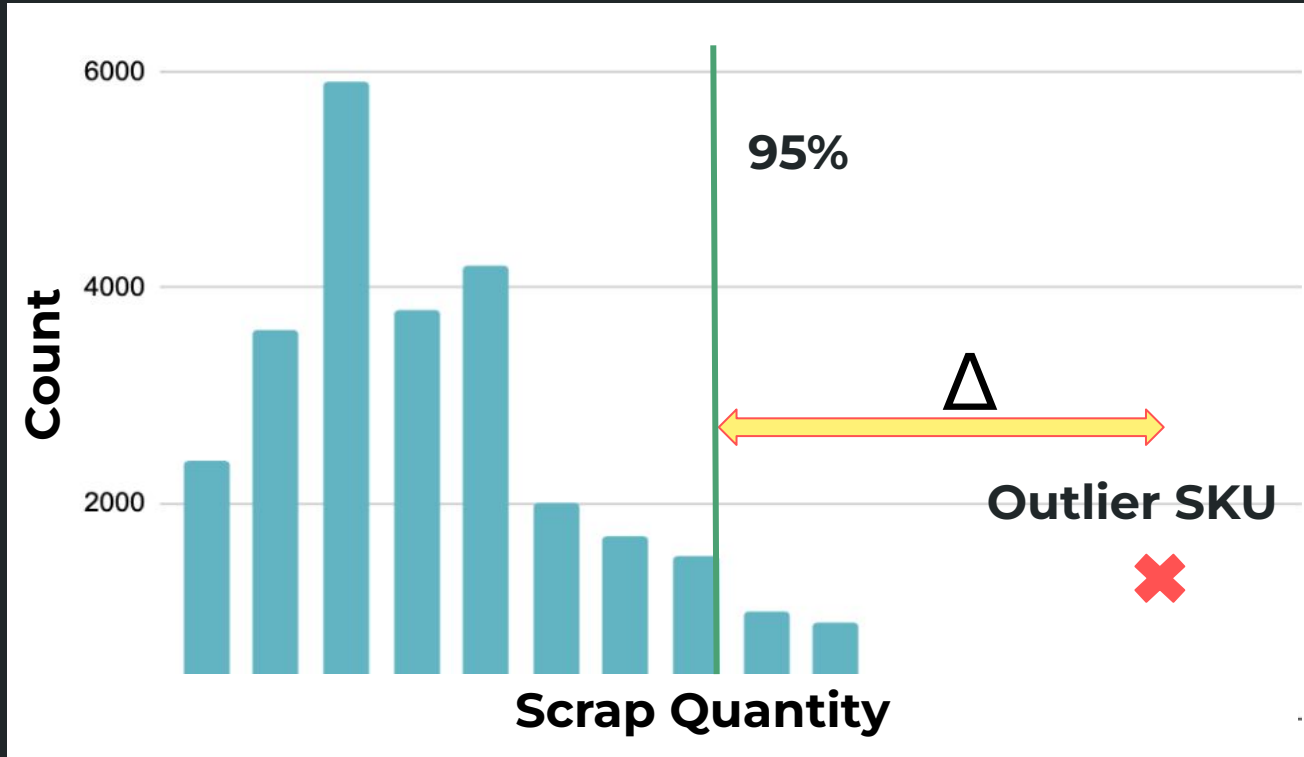

Identifying Outliers for Cluster 1 in 2022

Clustering Outcomes

Explanation of "Delta" (Δ)

* This histogram is for demonstration purposes only

Top 10 Outliers of Cluster 1

SKU Number	Unit Cost	Delta *	Financial Opportunity **
100015737	$ 18.71	8,177	$153,006
100040578	$ 1.80	48,993	$87,996
PPC1007	$ 0.82	32,333	$26,607
100022824	$ 1.99	10,740	$21,335
100021400	$ 1.14	18,676	$21,300
100020691	$ 16.56	1,127	$18,668
100026499	$ 0.87	19,513	$16,920
100036589	$ 1.19	11,912	$14,164
100038835	$ 2.70	4,664	$12,592
100022934	$ 0.65	18,591	$12,145

* The difference between the scrap quantity of the outlier SKU and the 95% quantity point of the non-outlier SKUs

** The unit cost amount multiplied by the delta value to get the potential monetary value of decreasing the scrap quantity of that SKU to be within the 95% interval

Investigating Top Outliers: Insights from Cluster 1

SKU = 100022934
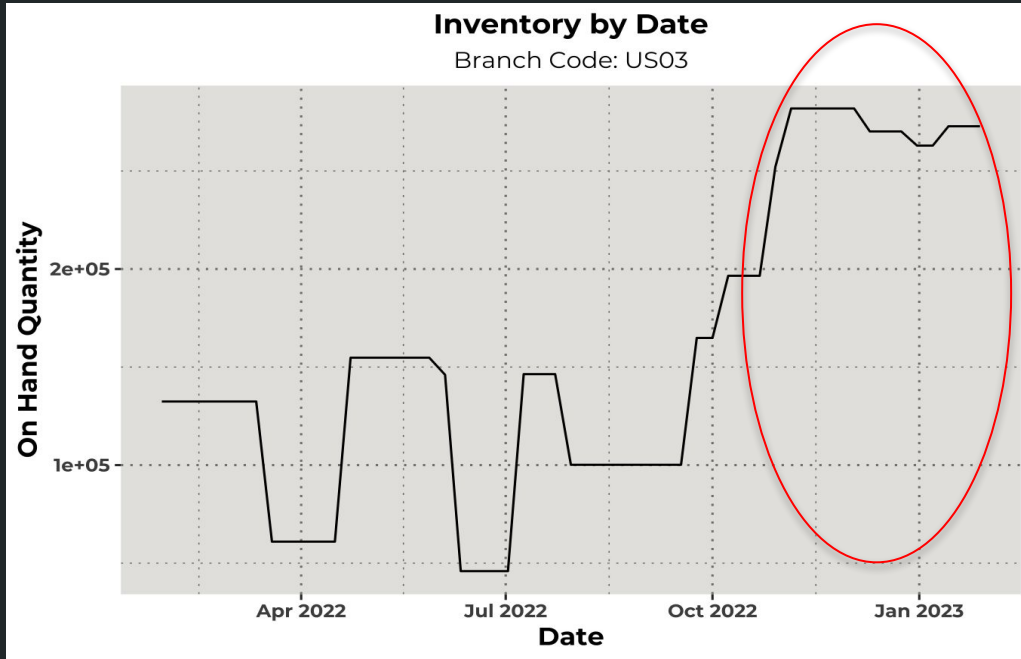
SKU Number	100022934
Year	2022
Scrap Reason	Expired
Total Scrap	8415

Investigating Top Outliers: Insights from Cluster 1

SKU = PPC1007

Year	Quality Issue	Dry Lines	Fibers	NULL	Welding
2018	2	1	1	15	148
2019	0	0	0	7	163
2020	0	0	0	3	132
2021	0	0	0	2	143
2022	0	0	0	2	145

Potential Savings Across Clusters

Cluster	Potential Savings for Top 10 SKUs	1% Savings	5% Savings	15% Savings	25% Savings
1	$384,732	$3,847	$19,237	$57,710	$96,183
2	$293,959	$2,940	$14,698	$44,094	$73,490
3	$282,018	$2,820	$14,101	$42,303	$70,505
4	$1,269,673	$12,697	$63,484	$190,451	$317,418
5	$2,428,416	$24,284	$121,421	$364,262	$607,104
...	...	...	...	...	...
Total	$7,777,899	$77,779	$388,895	$1,166,685	$1,944,475

A Future Tool for Screening

Thermo Fisher Scrap Identification

- ❖ A dynamic tool to pinpoint abnormally highly scrapped SKUs
- ❖ Will automatically create clusters based on the data being uploaded
- ❖ Thermo Fisher can choose settings to cater towards their preferences
- ❖ Helps ThermoFisher save time and resources rather than manually clustering

Conclusion

❖ Although scrap cannot be completely eliminated, there are many opportunities to reduce it

❖ Initial strategies to tackle excessive scrap involved a manual approach

❖ Some approaches fell short due to missing information and changes in a SKU's characteristics over time

❖ Clustering automatically groups SKUs into similar categories, which allows for more accurate prediction of outliers

❖ A dynamic screening tool for highly scrapped SKUs can save time and resources for Thermo Fisher

❖ Addressing the overlooked cost and impact of scrap can save Thermo Fisher millions annually

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