Defect Definers

TE533 - Lean Six Sigma

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Project Scope

DESCRIPTION

Analyze defect data by points

BACKGROUND

Most reporting for off-quality is done in terms of lengths of off-quality rolls with a primary defect accumulating that yardage. We would like to examine defects by a sum of points assigned in both 1st quality and off-quality rolls

GOAL

Provide analysis of points data that shows rate of defect by key categories

Define Stage

Problem Statement - The Elevate Textiles Finishing Plant experiencing an average of 8.31 defect points per 100 yards of fabric per week over the 2023-2024 fiscal year faces challenges in accurately deciphering the trends for the top contributing defect data points, contributing to a rise in the production of off-quality rolls/fabric, resulting in X amount of loss.

Mission Statement - Identify the key categories of defects based on the sum of defect points and uncover any underlying factors or relationship/trends, will reduce the production of off-quality rolls in 2024 by 5%, resulting in saving X amount.

Measurement Stage

- The data is sourced from the **DefectPoints.xlsx** spreadsheet
- Fabric rolls undergo a singular inspection process
- Defect pt/100 yards is the main factor which differentiates the product between 1st Quality, 2nd Quality and rework set respectively
- The defect points are categorized according to the designated defect category as seen in the table below
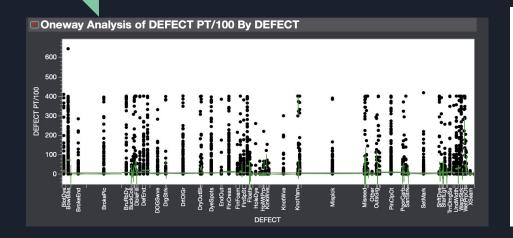
Example of the data in DefectPoints.xlsx

	WEEK	PRODUCT	BU	YDS	TOTAL POINTS	PTS PER 100	DEFECT	DEFECT PT/100	STYLE	FINISH	COLOR
1	2023 W01	00314 016 US 0398G 05H	BA	3088.8	508.6	15.69	Mispick	14.06	00314	016	0398G
2	2023 W01	00314 016 US 0398G 05H	BA	3088.8	508.6	15.69	EndOut	1.14	00314	016	0398G
3	2023 W01	00314 016 US 0398G 05H	BA	3088.8	508.6	15.69	PrpRngCr	0.19	00314	016	0398G
4	2023 W01	00314 016 US 0398G 05H	BA	3088.8	508.6	15.69	DyeSpots	0.06	00314	016	0398G
5	2023 W01	00314 016 US 0398G 05H	BA	3088.8	508.6	15.69	DrtOlGr	0.19	00314	016	0398G
6	2023 W01	00314 016 US 0398G 05H	BA	3088.8	508.6	15.69	KnotWve	0.03	00314	016	0398G

Analyze Stage - Defect Type

Oneway Analysis of DEFECT PT/100 By DEFECT

Table 2. Total Defect Points / 100 yards of Top 5 defects.

Defect	Total Defect Points / 100 Yards
Mispick	5060
BrokePic	2842
DrtOlGr	2712
SetMark	2448
KnotWve	2190

- Certain defects exhibit higher defect points, but are likely associated with the weaving plant or during the finishing process
- Defect codes, while important, are not the focal point for the defect analysis
- Cause for the defects were further categorized based on finish, style, color, and product based on the data

Analyze Stage - Finish

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
061	3	113.767	21.152	72.31	155.22
NFZ	6	71.140	14.956	41.82	100.46
18A	12	61.733	10.576	41.00	82.46
04A	4	59.628	18.318	23.72	95.53
002	62	36.344	4.653	27.22	45.46

Table 3. Normalized Mean Defect Points/100 yards for Finish

Finish	Number of Occurrences	Mean Defect points/100 yards	Normalized Mean Defect points/100 yards
075	8544	8.68	2.260207241
PF0	4093	9.019	1.125038614
018	2642	7.399	0.595762465
060	2362	7.874	0.5668166524
055	1475	11.723	0.5269847921

- Analysis revealed finishes 061, NFZ, 18A, and 04A showing the highest mean defect points despite fewer occurrences

- Normalization of data highlighted finishes 075, PF0, 018, 060, and 055 as top contributors to defect points per 100 yards, emphasizing the importance of closely monitoring these finishes due to their significant impact on product quality

Analyze Stage - Color

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
09147	1	366.920	36.010	296.3	437.50
0048H	1	233.330	36.010	162.7	303.91
0048G	1	230.180	36.010	159.6	300.76
0087V	2	166.770	25.463	116.9	216.68
08939	1	146.990	36.010	76.4	217.57

Table 5. Normalized Mean Defect Points/100 yards for Color.

Color Code	Number of Occurrences	Mean Defect points/100 yards	Normalized Mean Defect points/100 yards
0H944	1277	11.633	0.4527411008
0D263	1027	8.333	0.2608189382
0V183	632	6.604	0.1272012678
0709G	380	10.539	0.1220535170
00000	334	11.168	0.1136813361

- Colors such as 09147, 0048H, and 0048G showed highest mean defect points exceeding 200, despite fewer occurrences
- Normalization of data revealed a shift in top contributors to defect points per 100 yards, with colors 0H944, 0D263, 0V183, 0709G, and 00000 emerging as key contributors

Analyze Stage - Style

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
0B976	2	289.180	25.580	239.0	339.32
0C967	1	232.580	36.176	161.7	303.49
0B974	6	160.928	14.769	132.0	189.88
X2859	1	152.450	36.176	81.5	223.36
04942	3	136.890	20.886	96.0	177.83

Table 4. Normalized Mean Defect Points/100 yards for Style.

Style	Number of Occurrences	Mean Defect points/100 yards	Normalized Mean Defect points/100 yards
03011	1243	11.050	0.41858867
04043	1715	6.121	0.31991939
04423	1169	7.692	0.27403614
06132	373	20.163	0.22920181
03630	309	22.396	0.21090312

- Styles such as 0B976, 0C967, 0B974, and X2847 showed mean defect points exceeding 150

- Normalization of data identified top contributors to defect points per 100 yards, with styles 03011, 04043, 04423, 06132, and 03630 emerging as key areas

- Even styles with minimal occurrences demonstrated high defect points per 100 yards

Analyze Stage - Product

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
05698 075 US 09147 053	1	366.920	35.468	297.4	436.44
00618 015 US 0058S 06Q	2	306.565	25.079	257.4	355.72
0B976 FFB US 00472 03G	2	289.180	25.079	240.0	338.34
03838 017 US 00000 03M	1	249.100	35.468	179.6	318.62
06329 NFR US 0055P 03G	1	234.090	35.468	164.6	303.61

Table 6. Normalized Mean Defect Points/100 yards for Product.

Product	Number of Occurrences	Mean Defect points/100 yards	Normalized Mean Defect points/100 yards
03011 062 US 0H944 06G	365	16.886	0.18783951
04043 060 US 0H944 06G	517	7.61	0.11990644
0O529 018 US 0J017 06G	337	7.033	0.07223336
01183 018 US 0709G 033	355	6.593	0.07133107
04886 044 US 0024L 033	298	7.436	0.06753407

- Certain products, demonstrated highest mean defect points exceeding 200, despite fewer occurrences

- Normalization of data identified top contributors to defect points per 100 yards which are shown in Table 6, regardless of their occurrence frequencies

Improvement Stage - Current

- Installation of backlights on some of the inspection machines
- Lack of data to analyze the effectiveness of the improvement
- Conducted an interview with the longest tenured inspection worker who repeatedly insisted such backlights were a critical improvement

Improvement Stage - Suggested

1. Timestamp for granular time trend analysis

2. External factors analysis

3. Operator data

4. Data completeness

5. AI Inspection

Control Stage

In the control stage, it is important to note that due to project timeline constraints, control procedures could not be implemented at this juncture. As such, the team did not have the opportunity to engage in this stage currently, and no actions were taken in this regard.

Conclusion

- Our project uncovered insights into Elevate Textiles Finishing Plant's quality control processes.
- Involving stakeholders from the outset could align efforts with organizational objectives.
- Additional comprehensive data, including operator identification and external factors, would have bolstered our analysis.
- Despite hurdles, we've identified areas for process enhancement.
- Moving forward, refining scope and stakeholder collaboration will fuel quality and efficiency gains.