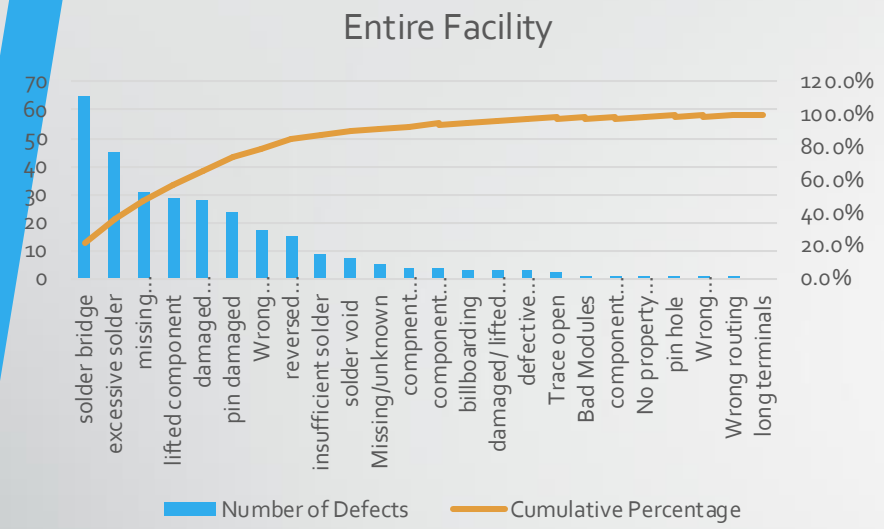
# Manufacturing Defect Analysis

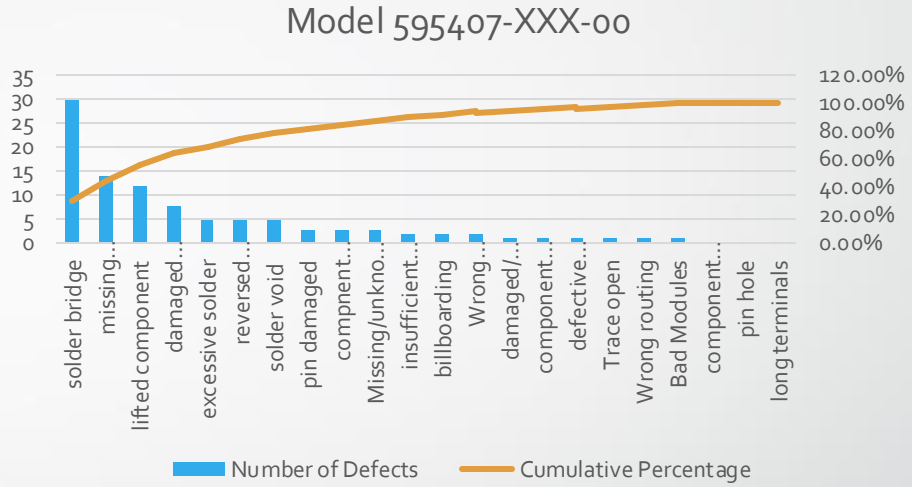
Elijah Cruz

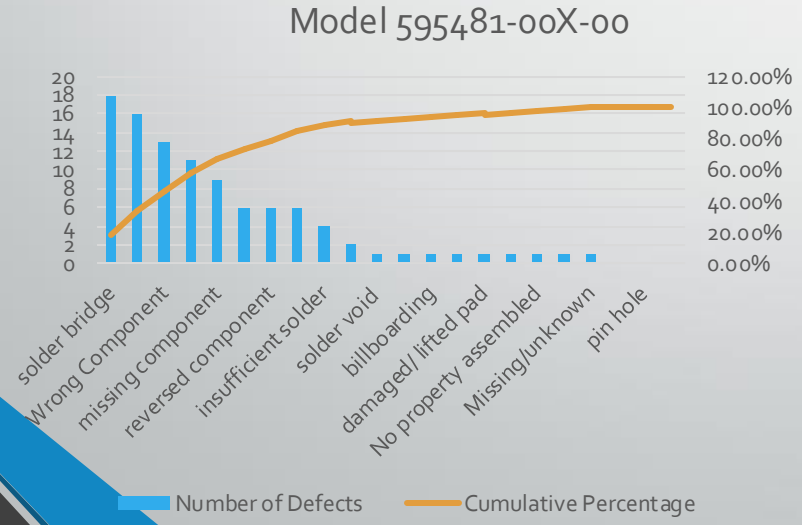
# Growing Defect Concerns

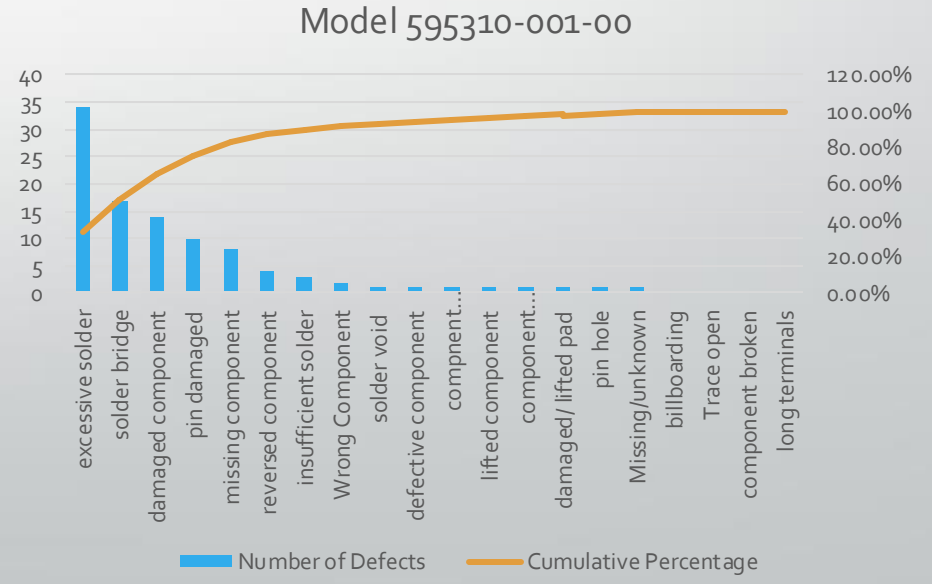
- The company has seen an increase in demand for manufactured products.
- Surge in defects
- These issues, specifically related to the welding process, include lifted components, solder bridges, insufficient solder, missing components, excessive solder, and damaged components.
- Fixing defects after production is costly.
- Compliance with the IPC-A-610E standard for electronic components requires that the product defects are corrected prior to release.
- Goals : a 20% reduction in defects generated during the welding process and a 20% increase in the capacity of the electronic boards three double production lines; without increasing the defect percentage

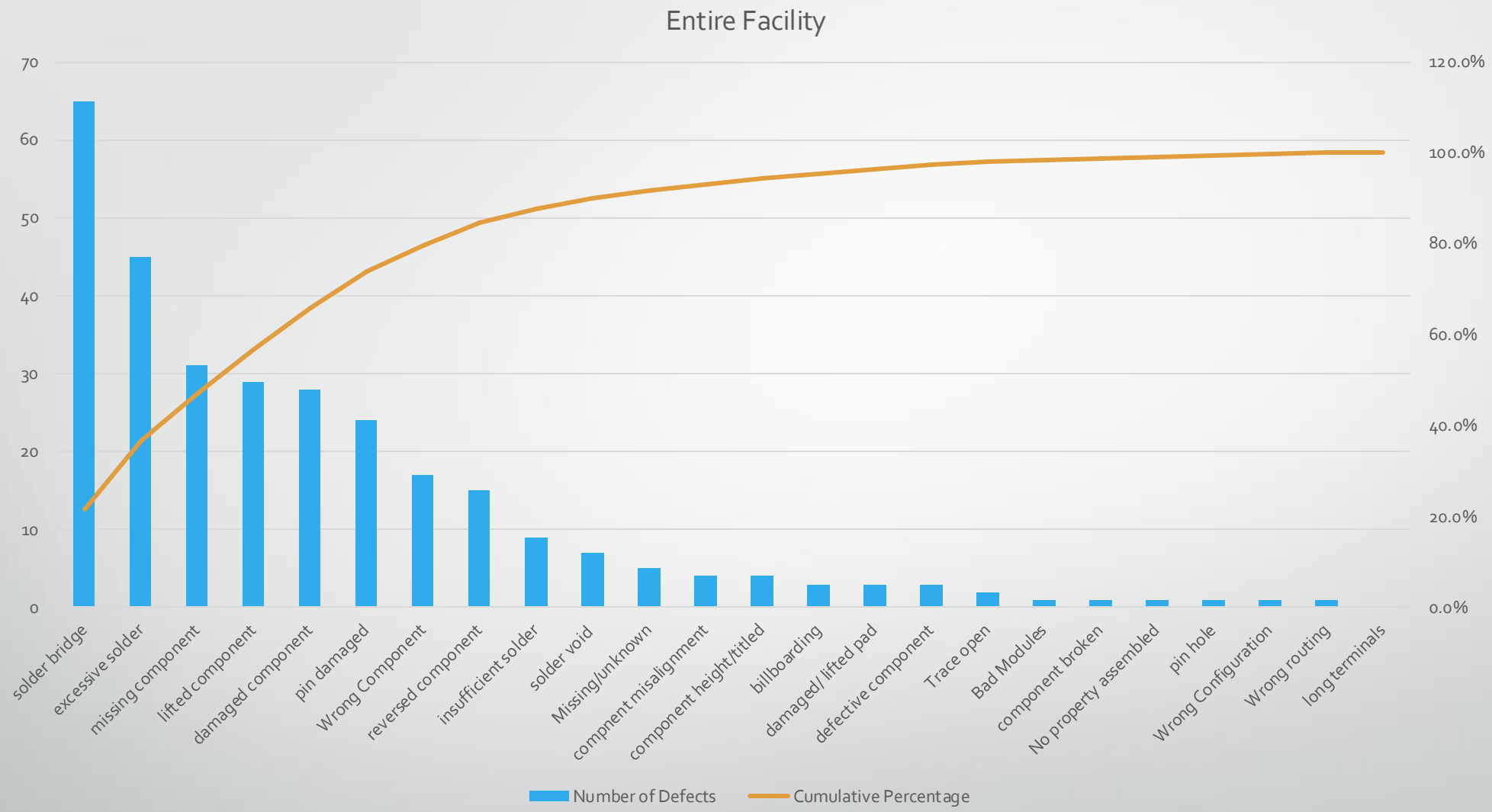
# Pareto Charts

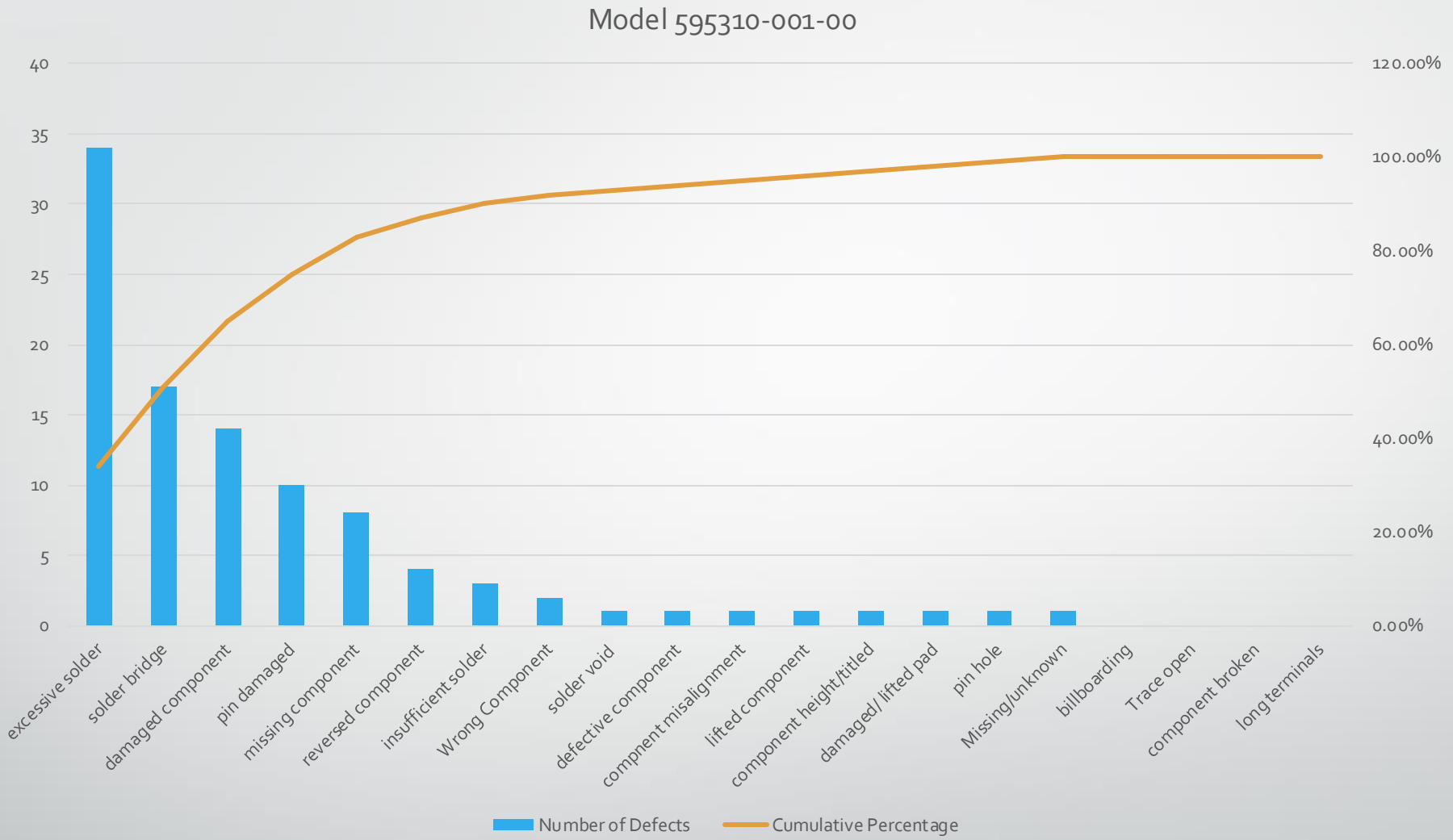


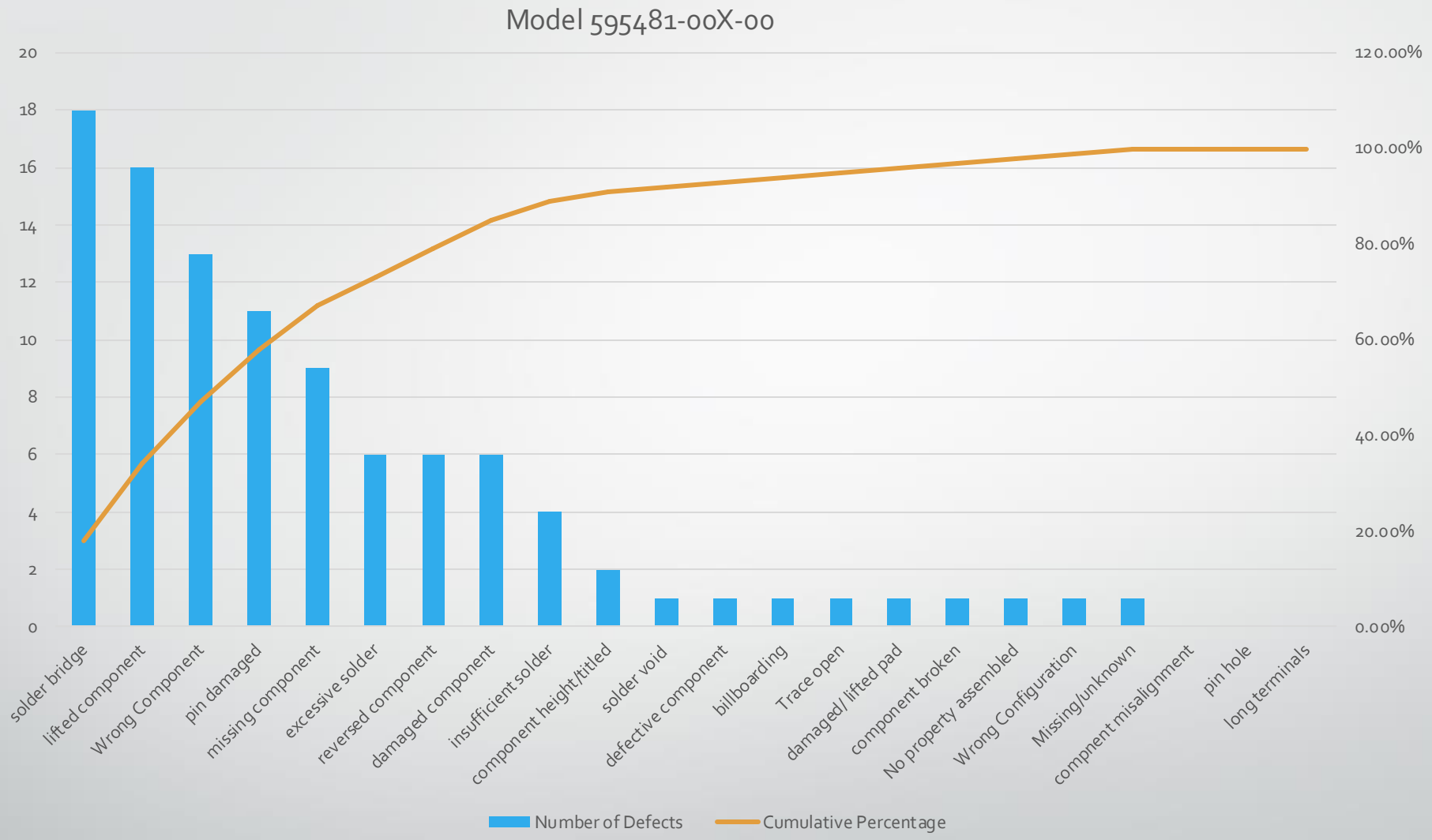



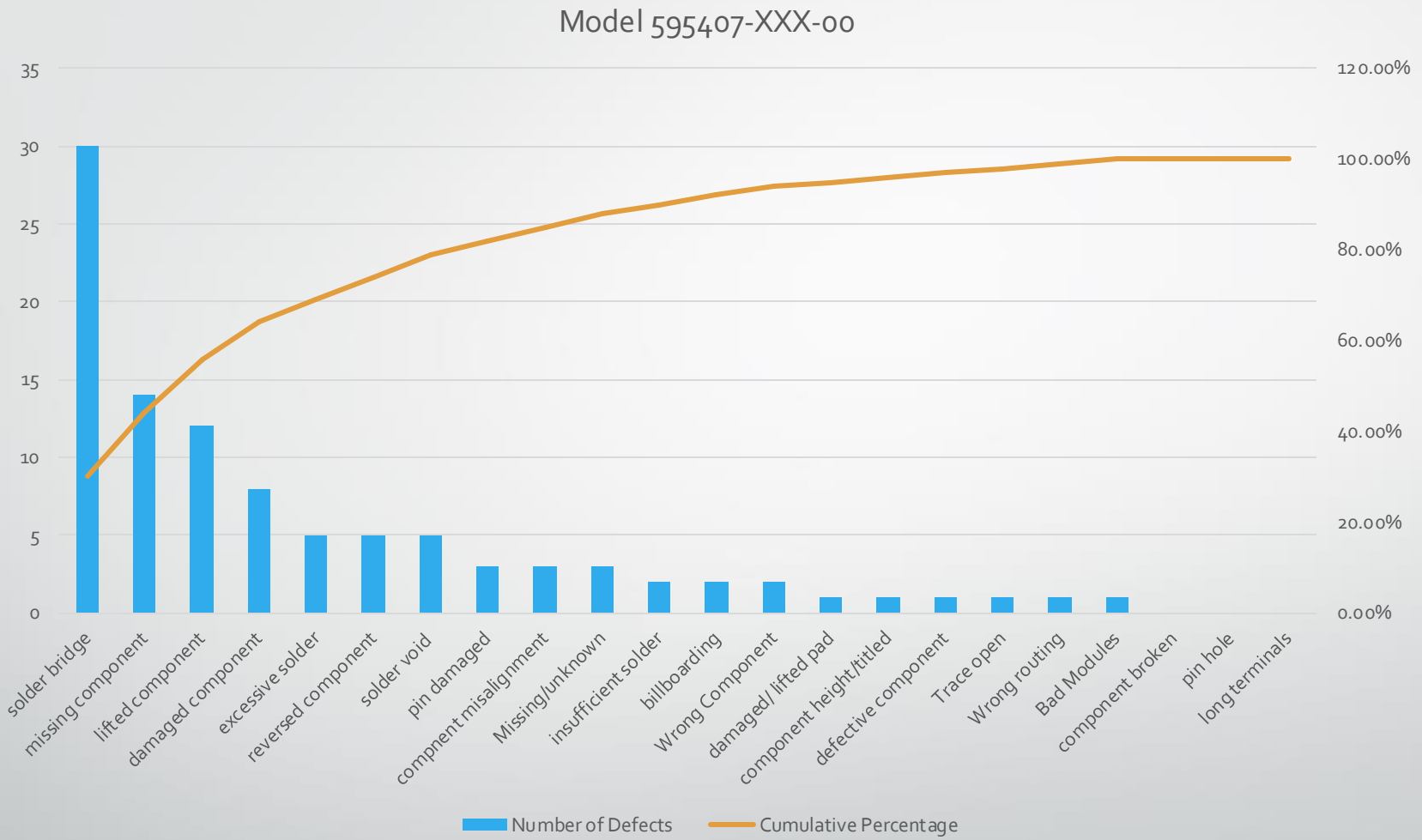




Entire Facility
70
60
50
40
30
20
10
0
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
solder bridge
excessive solder
missing component
lifted component
damaged component
pin damaged
Wrong Component
reversed component
insufficient solder
solder void
Missing/unknown
compnent misalignment
component height/titled
billboarding
damaged/ lifted pad
defective component
Trace open
Bad Modules
component broken
No property assembled
pin hole
Wrong Configuration
Wrong routing
long terminals
Number of Defects
Cumulative Percentage


Model 595310-001-00
40
35
30
25
20
15
10
5
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
excessive solder
solder bridge
damaged component
pin damaged
missing component
reversed component
insufficient solder
Wrong Component
solder void
defective component
compnent misalignment
lifted component
component height/titled
damaged/lifted pad
pin hole
Missing/unknown
billboarding
Trace open
component broken
long terminals
Number of Defects
Cumulative Percentage


Model 595481-00X-00
20
18
16
14
12
10
8
6
4
2
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
solder bridge
lifted component
Wrong Component
pin damaged
missing component
excessive solder
reversed component
damaged component
insufficient solder
component height/titled
solder void
defective component
billboarding
Trace open
damaged/ lifted pad
component broken
No property assembled
Wrong Configuration
Missing/unknown
compnent misalignment
pin hole
long terminals
Number of Defects
Cumulative Percentage


Model 595407-XXX-00
35
30
25
20
15
10
5
0
120.00%
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
solder bridge
missing component
lifted component
damaged component
excessive solder
reversed component
solder void
pin damaged
compnent misalignment
Missing/unknown
insufficient solder
billboarding
Wrong Component
damaged/ lifted pad
component height/titled
defective component
Trace open
Wrong routing
Bad Modules
component broken
pin hole
long terminals
Number of Defects
Cumulative Percentage

# Hypothesis Test

- A Hypothesis Test will be used
- With the objective of keeping correction/repair costs down the test will allow a review to determine if the problems are with a specific model or the entire facility.
- A one-way ANOVA test will be used
- The ANOVA test will be: There is no significant difference among the means of the three production lines (Ho: $\mu 1 = \mu 2 = \mu 3$) There is at least one difference between the three means with a = .05 (Ha: $\mu 1 \neq \mu 2 \neq \mu 3$)

In the ANOVA test we see that the F statistic (2, 12) is 5.285 and significance (P-Value) is .023. Showing that the P Value is less than the alpha value of .05.

There is a significant difference between the means of the three production lines.

Allowing the null hypothesis, that states there isn't a significant difference between the means of the three production lines (models), to be rejected.

**Oneway**

**ANOVA**

Percentage

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 369.554 | 2 | 184.777 | 5.285 | .023 |
| Within Groups | 419.542 | 12 | 34.962 | | |
| Total | 789.096 | 14 | | | |

Post hoc tests are conducted when the ANOVA test indicates a significant difference, allowing for a more detailed analysis of group differences.

Multiple Comparisons test highlights the relationships between the models.

Difference between Model 1 and Model 2, as well as between Model 1 and Model 3, since the p-values are less than the alpha level.

No significant difference between Model 2 and Model 3 because the p-value is greater than the alpha, so the null hypothesis is not rejected .

## Post Hoc Tests

### Multiple Comparisons

Dependent Variable: Percentage

Tukey HSD

| (I) Group | (J) Group | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Model 1 | Model 2 | 10.65400* | 3.73962 | .036 | .6772 | 20.6308 |
| | Model 3 | 10.40000* | 3.73962 | .041 | .4232 | 20.3768 |
| Model 2 | Model 1 | -10.65400* | 3.73962 | .036 | -20.6308 | -.6772 |
| | Model 3 | -.25400 | 3.73962 | .997 | -10.2308 | 9.7228 |
| Model 3 | Model 1 | -10.40000* | 3.73962 | .041 | -20.3768 | -.4232 |
| | Model 2 | .25400 | 3.73962 | .997 | -9.7228 | 10.2308 |

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets test helps identify where significant differences exist between the groups.

It indicates that the mean for Model 1 is significantly higher than those for Model 2 and Model 3.

Model 2 and Model 3 appear in the same column

**Homogeneous Subsets**

**Percentage**

Tukey HSD[a]

| Group | N | Subset for alpha = 0.05 | |
|---|---|---|---|
| | | 1 | 2 |
| Model 2 | 5 | 3.0460 | |
| Model 3 | 5 | 3.3000 | |
| Model 1 | 5 | | 13.7000 |
| Sig. | | .997 | 1.000 |

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 5.000.

- **ANOVA Results:** Significant differences found in mean defect rates across production lines
- **Post Hoc Analysis:**
- Model 1 has a significantly higher defect rate than Models 2 and 3
- Models 2 and 3 show no significant difference from each other
- **Action Plan:**
- Prioritize improvements on **Model 1**
- Extend corrective measures to Models 2 & 3 after Model 1 enhancements
- **Use of Pareto Charts (Slides 4–7):**
- Identify key defect contributors on each line
- Target high-impact areas for process improvement
- **Goals:**
- **20% reduction** in welding process defects
- **20% increase** in production capacity across all double lines

# RESOURCES


- Clinical Excellence Commission. (n.d.). Pareto Charts & 80-20 rule - Clinical Excellence Commission. https://www.cec.health.nsw.gov.au/CEC-Academy/quality-improvement-tools/pareto-charts
- Kenton, W. (2024, July 30). *What is analysis of variance (ANOVA)?* Investopedia. https://www.investopedia.com/terms/a/anova.asp
- Raeburn, A. (2025, January 19). Create an effective action plan in 6 steps [2025] • Asana. *Asana*. https://asana.com/resources/action-plan
- Realyvásquez-Vargas, A., Arredondo-Soto, K. C., Carrillo-Gutiérrez, T., & Ravelo, G. (2018). Applying the Plan-Do-Check-Act (PDCA) cycle to reduce the defects in the manufacturing industry: a case study. *MDPI*. https://learn.snhu.edu/content/enforced/1860641-DAT-475-11796.202516-1/course_documents/DAT%20475%20Project%20Case%20Study.pdf?ou=1860641