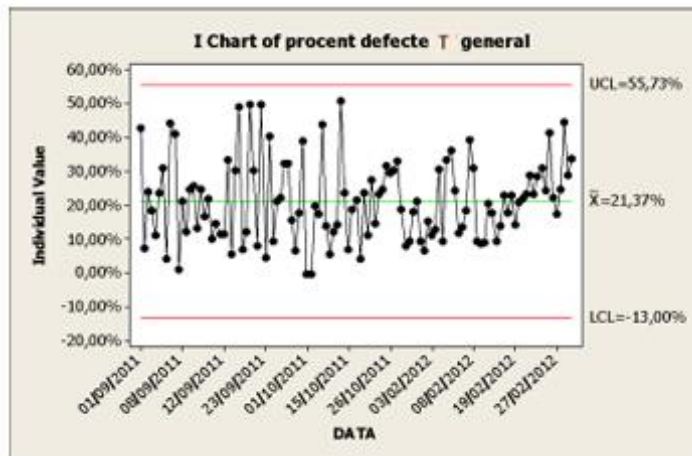# Case Study
Process Optimization Through Six Sigma Methodology

Initial Situation:

- **The client was experiencing a high incidence of cosmetic defects on one of their products.**
- **These defects originated during the plastic injection molding process performed on a vertical injection machine**

Activities performed:

- **The client participated in Six Sigma training with EFFECTIVE FLUX and, in parallel, worked on the project between training modules**
- **The consultant monitored and provided support throughout the project implementation over a six-month period**

Project Implementation:

- **The improvement project was carried out following the Six Sigma DMAIC methodology.**
- **Define > Measure > Analyze > Improve > Control**
- **To ensure fast and accurate data processing, the MINITAB software was used**
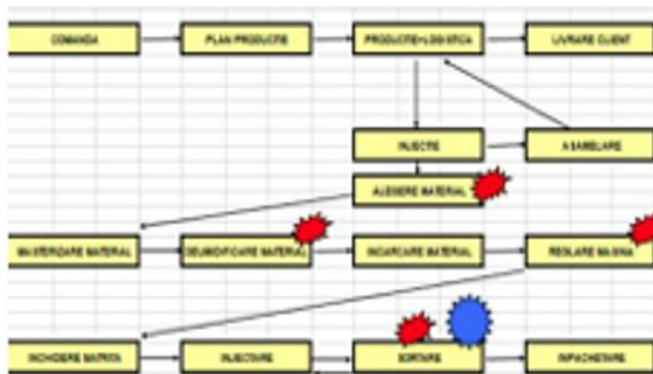
Define:

- Design the project charter.
- Define the project objective: Decrease the reject rate from 21% to 13%
- Estimate the savings: 18000 Euro / year

Measure:

- In this phase, the process was described and the areas where the root causes would be investigated were identified.
- Potential causes were identified using the IPO diagram and the Prioritization Matrix
- The 7 most significant factors were selected out of the 44 initially identified
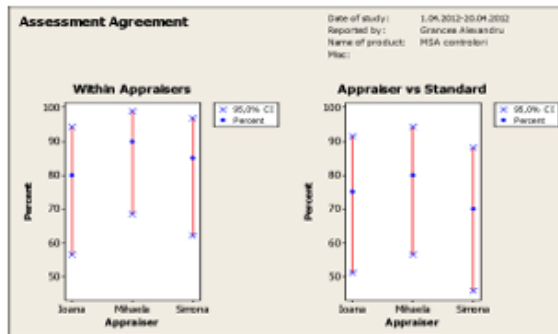- The accuracy of defect inspection was verified using MSA, and actions were taken to improve it
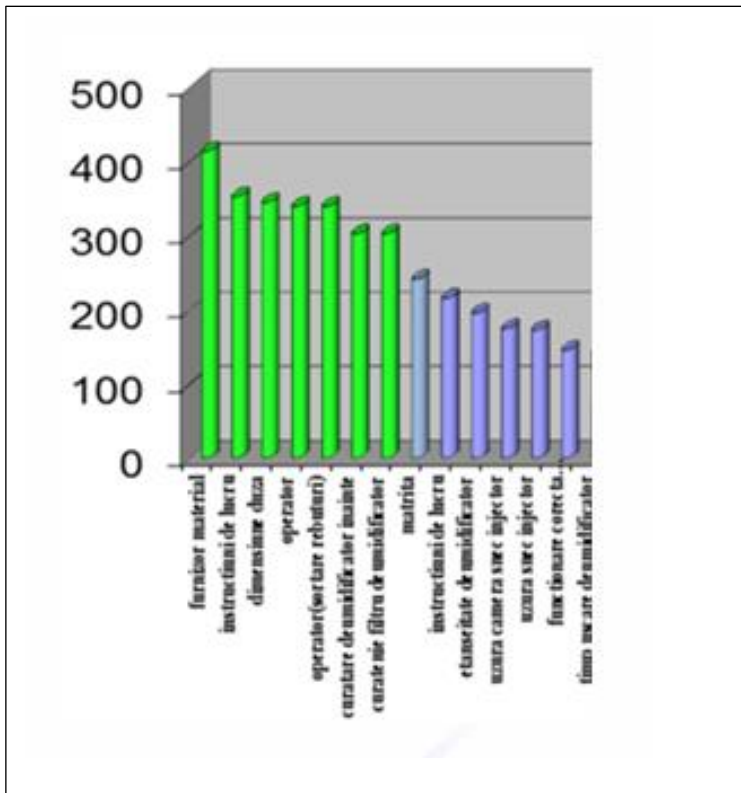
Case Study

Measure

Measure:

- We defined the data collection plan.
- Each variable was described in detail, including how, where, by whom, and with what it would be collected.

Measure:

- To prevent measurement errors, the accuracy of defect inspection was verified using MSA.
- It was found that improvements to the measurement system were necessary, and corrective actions were taken
- The measurement system accuracy was re-evaluated and found to be capable
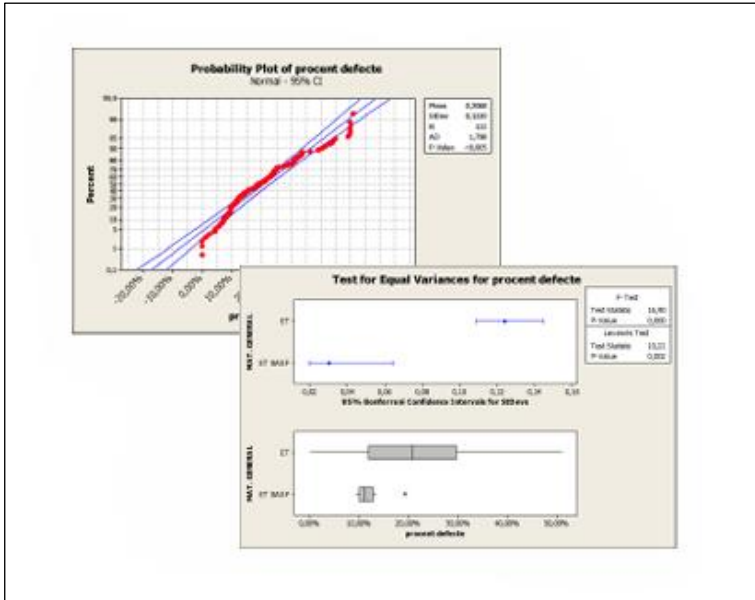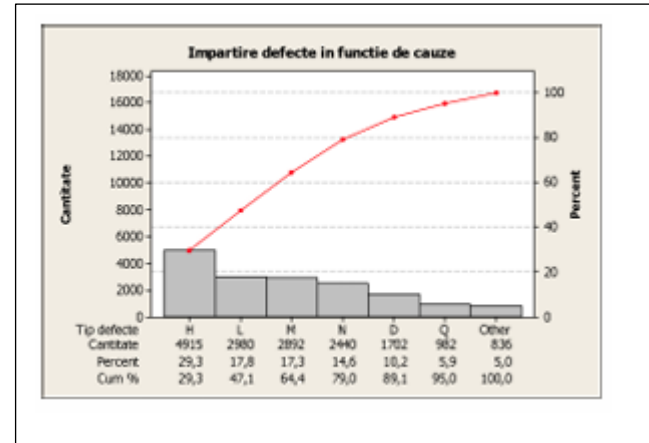

- We collect data.

Case Study

Analize

Graphical analysis:

- Based on the collected data, graphical analyses were performed.
- Graphical tools such as Pareto charts, Box Plots, and Histograms provided stronger insights into the potential causes.

Analytical analysis:

- Analytical analysis was performed using Hypothesis Testing techniques.
- Tools used: Normality Test, ANOVA, Mood's Median Test.
- Only two factors were proven to be actual causes (with a statistically significant impact on the defect rate): the machine and the supplier.


```
Mood median test for procent defecte
Chi-Square = 5,73      DF = 1      P = 0,017

MAT.                                Individual 95,0% CIs
GENERAL   N<=   N>   Median   Q3-Q1   -----+---------+---------+---------+-
ET        59    65   0,206    0,177                    (------*------)
ET BASF    8     1   0,109    0,028   (-+----)
                                      -----+---------+---------+---------+-
                                        0,120     0,160     0,200     0,240

Overall median = 0,189

A 95,0% CI for median(ET) - median(ET BASF): (0,057;0,114)
```
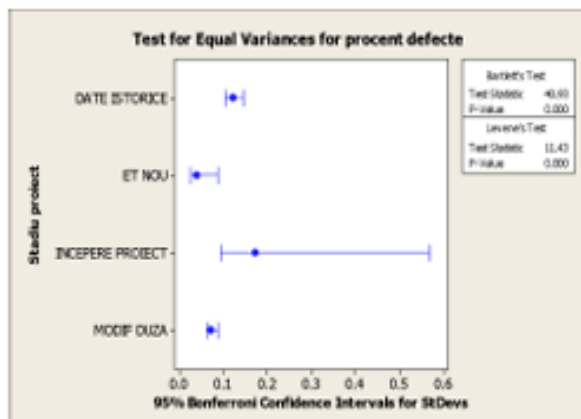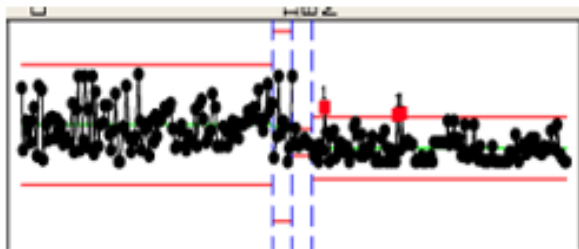
Case Study
Improvement

Implemented measures:

- **For the machine: the injection rod length was adjusted.**
- **For the suppliers: the supplier was changed.**
- **Other measures: periodic checks of the humidifier and periodic verification of the inspection accuracy**

Verification of the impact of the measures:

- **Using the control chart, it was observed that after implementation, the average defect rate decreased from 21% to 8%.**
- **Hypothesis testing tools were used to demonstrate whether the improvement was statistically significant.**
- **It was thus proven that, after the final implemented measures, the improvement is statistically significant**
- **Recalculated annual savings: €32,500**

Test for Equal Variances for procent defecte


```
Mood Median Test: procent defecte versus Stadiu proiect

Mood median test for procent defecte
Chi-Square = 63.02    DF = 3    P = 0.000

                                          Individual 95.0% CIs
Stadiu proiect   N<=  N>  Median  Q3-Q1   --------+---------+---------+---------
DATE ISTORICE     30   90  0.208   0.177                        (--*-)
ET NOU             8    2  0.099   0.033          (--*)
INCEPERE PROIECT   2    4  0.155   0.216   (---------------*----------------------)
MODIF DUZA        85   28  0.071   0.100   (*-)
                                          --------+---------+---------+---------
                                              0.10      0.20      0.30

Overall median = 0.118
```

Case Study
Control. Project closure

Measures to Sustain Improvements:

- **Updating instructions/procedures for determining the nozzle size and selecting the material supplier.**
- **Modifying the procedure for inspector evaluation.**

Deployment:

- **The deployment of the measures to other processes was evaluated.**
- **It was decided to implement the same measures in a similar process at another plant within the group.**

Project closure:

- **Documented with a Sign-Off Sheet.**
- **This document includes the objective – defect rate, initial state (21%), target (13%), and achieved value (8%).**
- **It was approved by the hierarchical manager, the financial representative, and the General Manager**