Monitor, Understand, and Optimize Your Process: A Manufacturing Case Study

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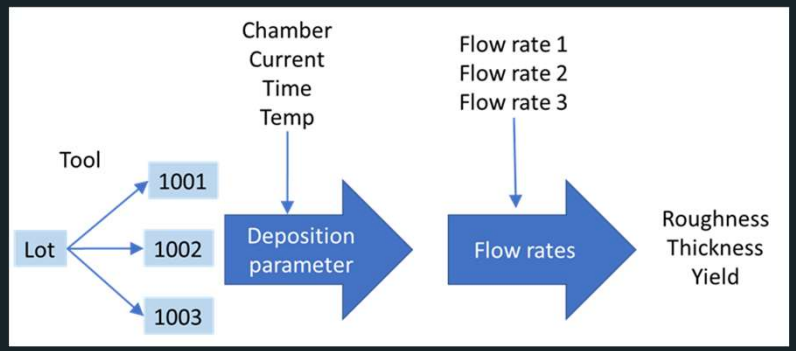
jmp STATISTICAL DISCOVERY FROM SAS

Manufacturing Case Study

Semiconductor Chemical Vapor Deposition (CVD)

- Three tools in a process.
- Four deposition chambers per tool.
- Temperature, time, and current are controlled.
- Three chemicals are fed into the chamber via mass flow controllers.
- Three quality metrics on final product: Roughness, Thickness, and Yield



CVD Case Study

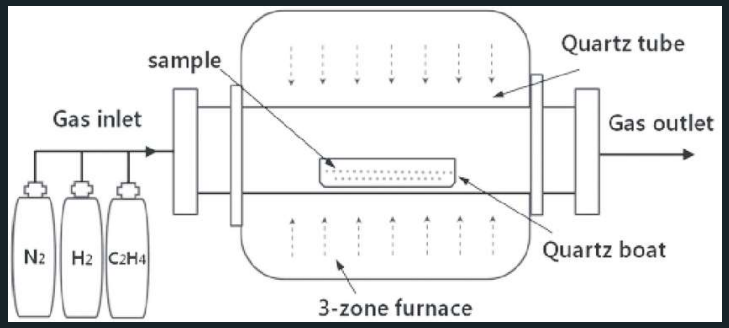
Problem Statement

Problem Statement:

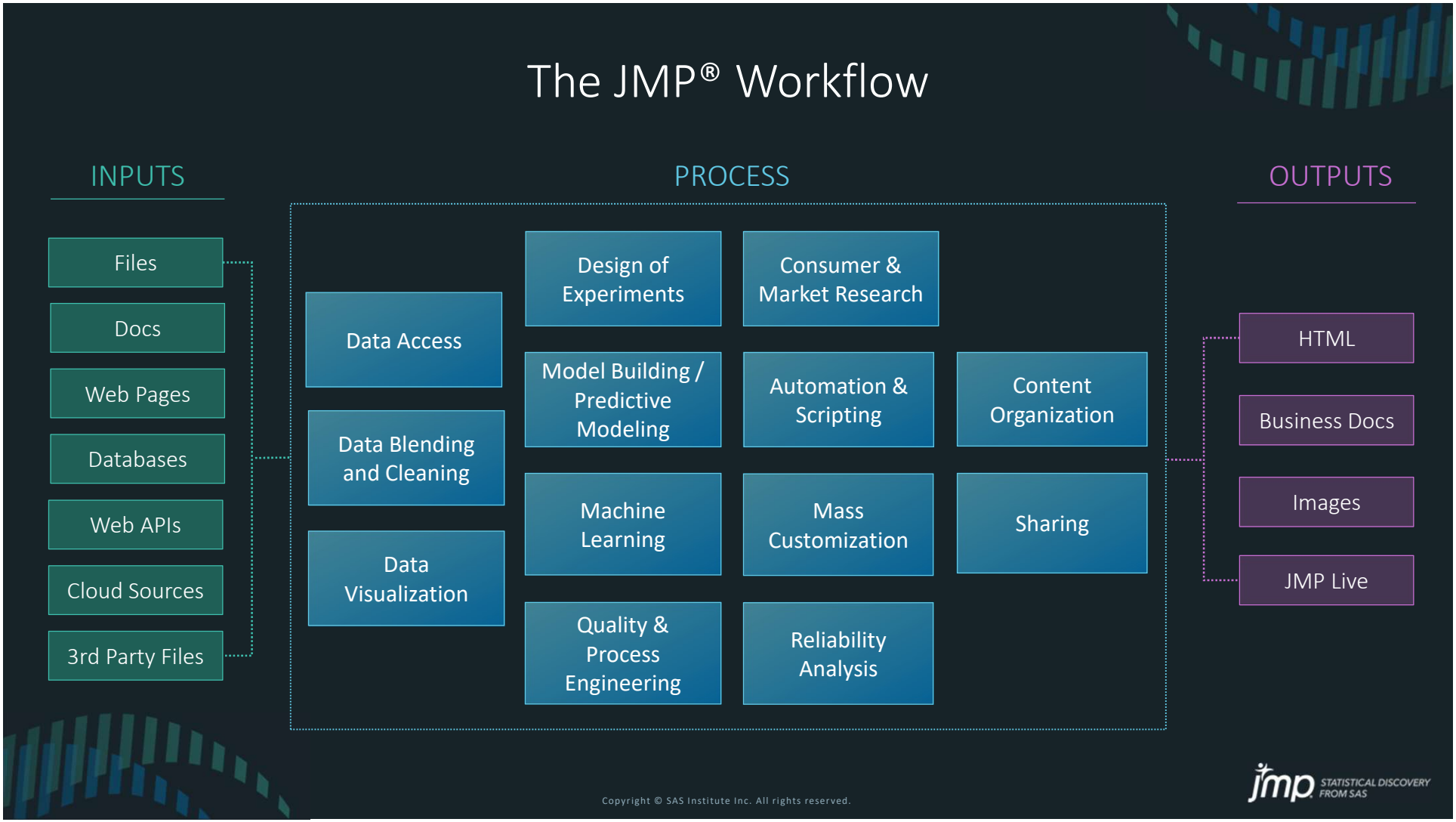
- >25% of recent lots failed to meet specification.

Goal:

- Identify process variables that contribute to rejects.
- Find optimal process settings
  - Minimize deposition thickness
  - Minimize roughness
  - Maximize yield.



The JMP® Workflow



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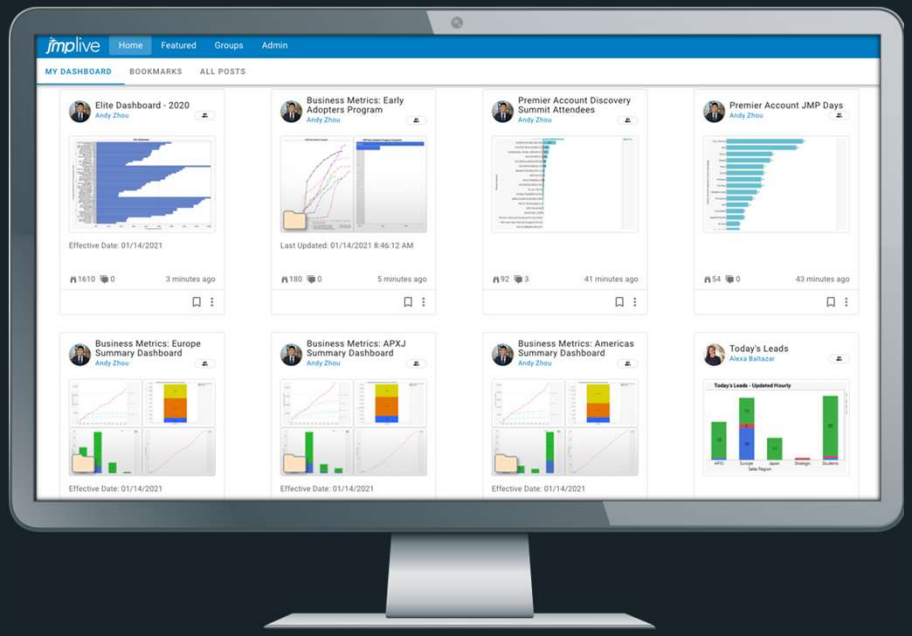
DISCOVERY DELIVERED



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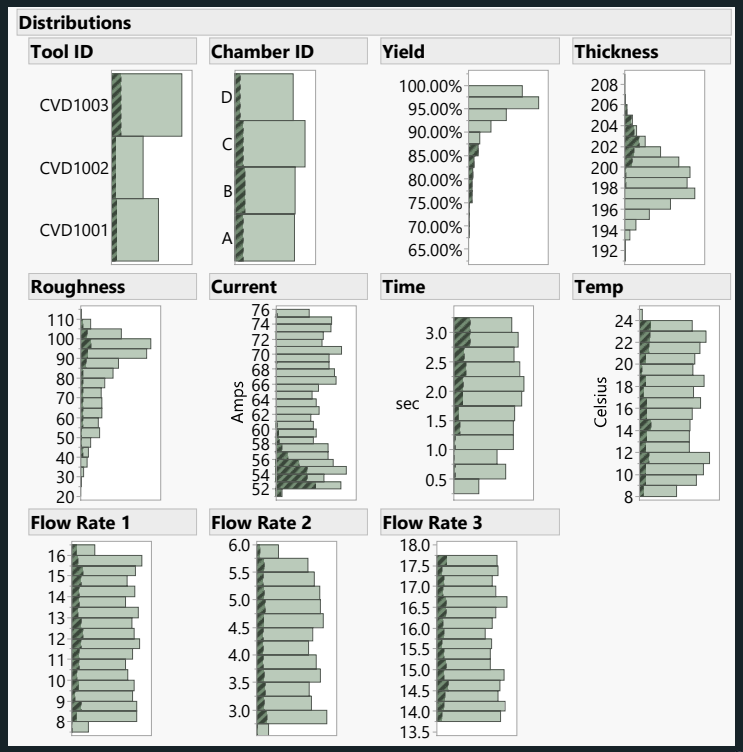
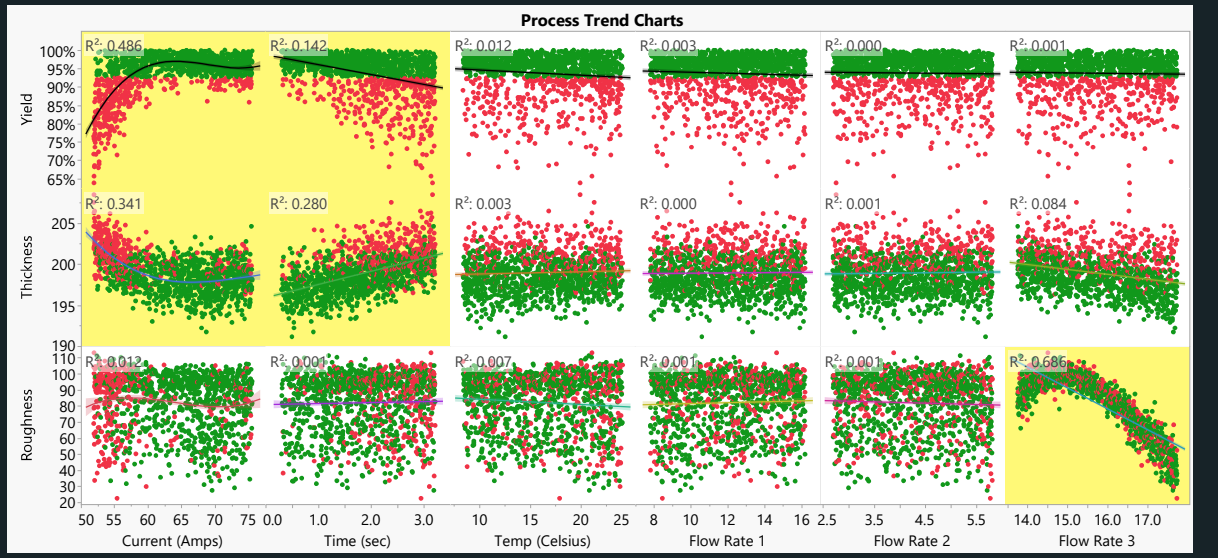
Graphical Analysis: Distribution

- Gain insights about variables AND the relationships between variables with dynamic linking.



Graphical Analysis: Graph Builder

- Quickly create and experiment with plots until you find the one you want.
- Use different graphical elements to unlock the story and focus attention.



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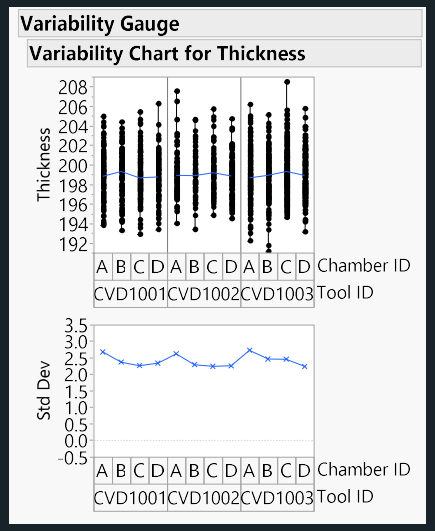
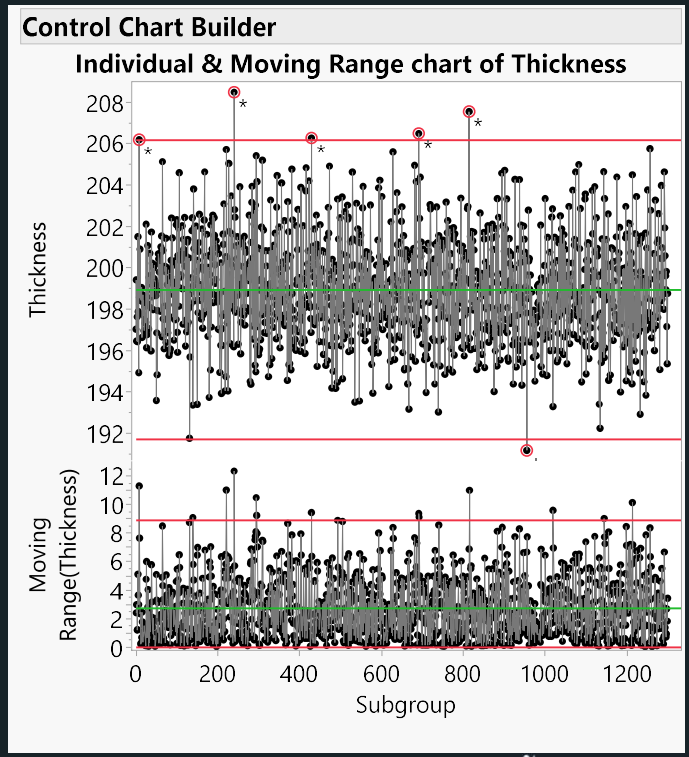
Graphical Analysis: Quality and Process

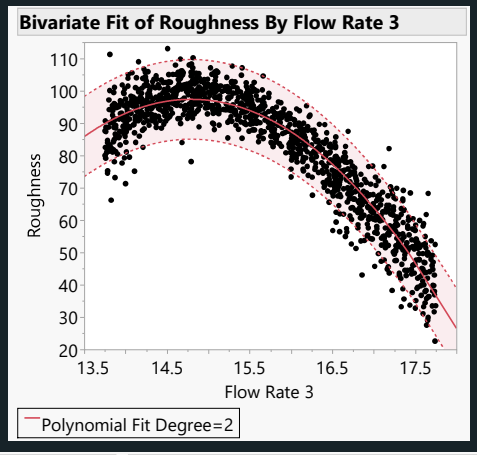
- Visualize process variation.
- Identify opportunities for process improvement.

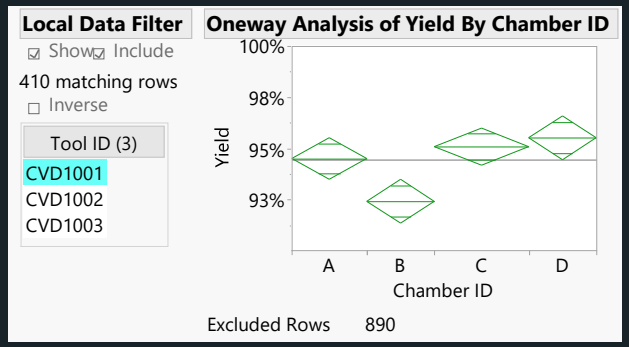




Graphical & Statistical Analysis: Fit Y by X

- Compare two variables.
- Hypothesis tests
  - Ho: no relationship
  - Ha: relationship
- Type of comparison depends on Data Type and Modeling Type.
- Caution – Interacting variables can bias results!





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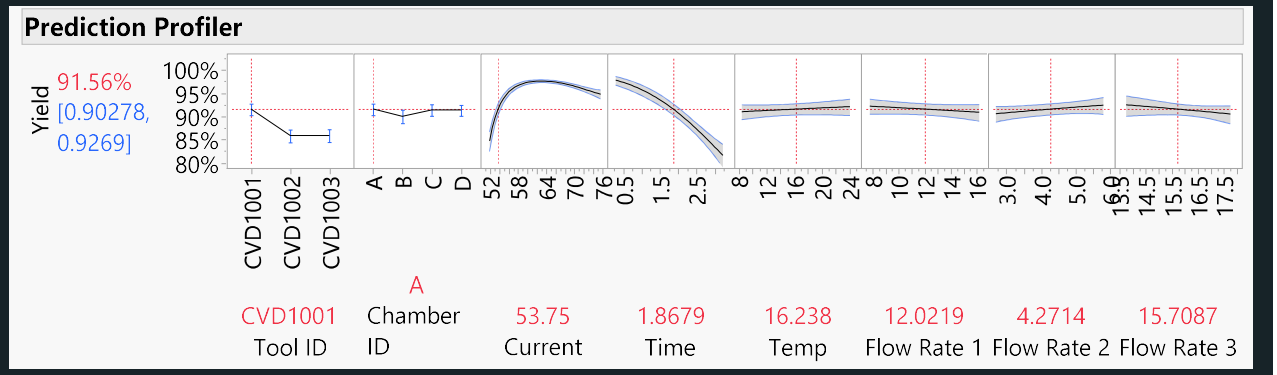
Graphical & Statistical Analysis: Fit Model

- Fit and visualize a regression model that is a function of multiple variables.
- Gain process knowledge.
- Find opportunities for improvement.

$$Y = f(X) + error$$

$$f(x) = \beta_0 + \sum_{i=1}^{p} \beta_i x_i + \sum_{i=1}^{p} \sum_{j=i+1}^{p} \gamma_{i,j}\, x_i x_j + \sum_{i=1}^{p} \delta_i x_i^2$$



Thank You for Attending!

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