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Components of Variation Statistical Selection of Factors For a Design of Experiment (DOE)

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Components of Variation (COV)

- To appreciate the value of a COV, one needs to evaluate one's reason for doing a Design of Experiment (DOE) and one's understanding/philosophy for this type of experimental approach.

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Design of Experiment

What is the intent or purpose of a DOE?

- What is the real advantage to a DOE?
  - Is it the time savings for being able to do more than one factor at a time?
  - Is it to understand the ranges of the selected factors?
- The real advantage of a DOE is:
  - To be able to learn about factor interactions
    - Primarily two-way and three-way interactions for most commonly designed studies.

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Design of Experiment

How is a DOE typically designed?

- Factor Selection
  - The number of factors selected realistically should not be more than 5. Typically, most DOEs only have 3 or 4 factors.
  - Selection is typically based on experience or known science as being key factors (key main effects). This approach does not truly consider effects resulting from interactions.
  - Can have a strong interaction from two seemingly minor factors, this interaction can be stronger than a single “main” factor.

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Design of Experiment

How should the factors be selected?

- Factor selection should be based on a planned study that analyzes many potential factors over a wider range than is studied in a DOE.
  - Designed to understand if there are any statistically significant interactions.
  - Also, which factors are truly statistically significant for the process under study.

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Components of Variance (COV)

When resolving an issue, the COV approach:

- Also known as an Analysis of Variance (ANOVA)
- Use this approach to screen factors, statistically, to determine what factors should be in the DOE.
- Use this approach to determine which factors have the significant interactions that need further study.

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Components of Variation (COV)

- Design allows for study to be crossed or nested thereby maximizing the ability to determine the potentially significant factor interactions.
- Used to identify a Lurking Variable. Lurking variables cannot be identified in a DOE.
- Lurking variables can confound the outcome of a DOE.

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Components of Variance (COV)

- In essence, the COV is like a ‘funnel’ for the DOE. A study design is executed that has many factors inputted into the study, with wide study ranges. The statistical output of this study determines which factors will be selected for the ensuing DOE.

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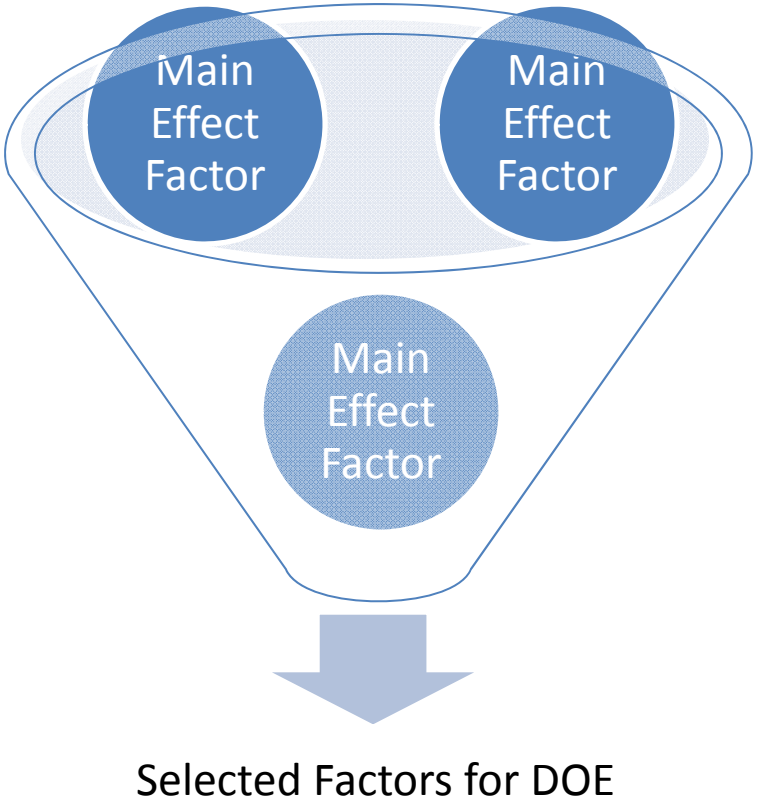
- COV is essentially a funnel:
- DOE should not be done without first doing a COV.



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COV Design

- At the onset, design the ultimate COV.
  - Include all possible sources of variability
  - Then look at the total design “tree”
  - Now decide if the entire “tree” is going to be executed or a part of it that seems more significant, for the study at hand.
    - This partitioning of the study would only be considered if the study is design is impractically large, with regards to time and cost constraints.

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EXAMPLES OF COV STUDY DESIGNS

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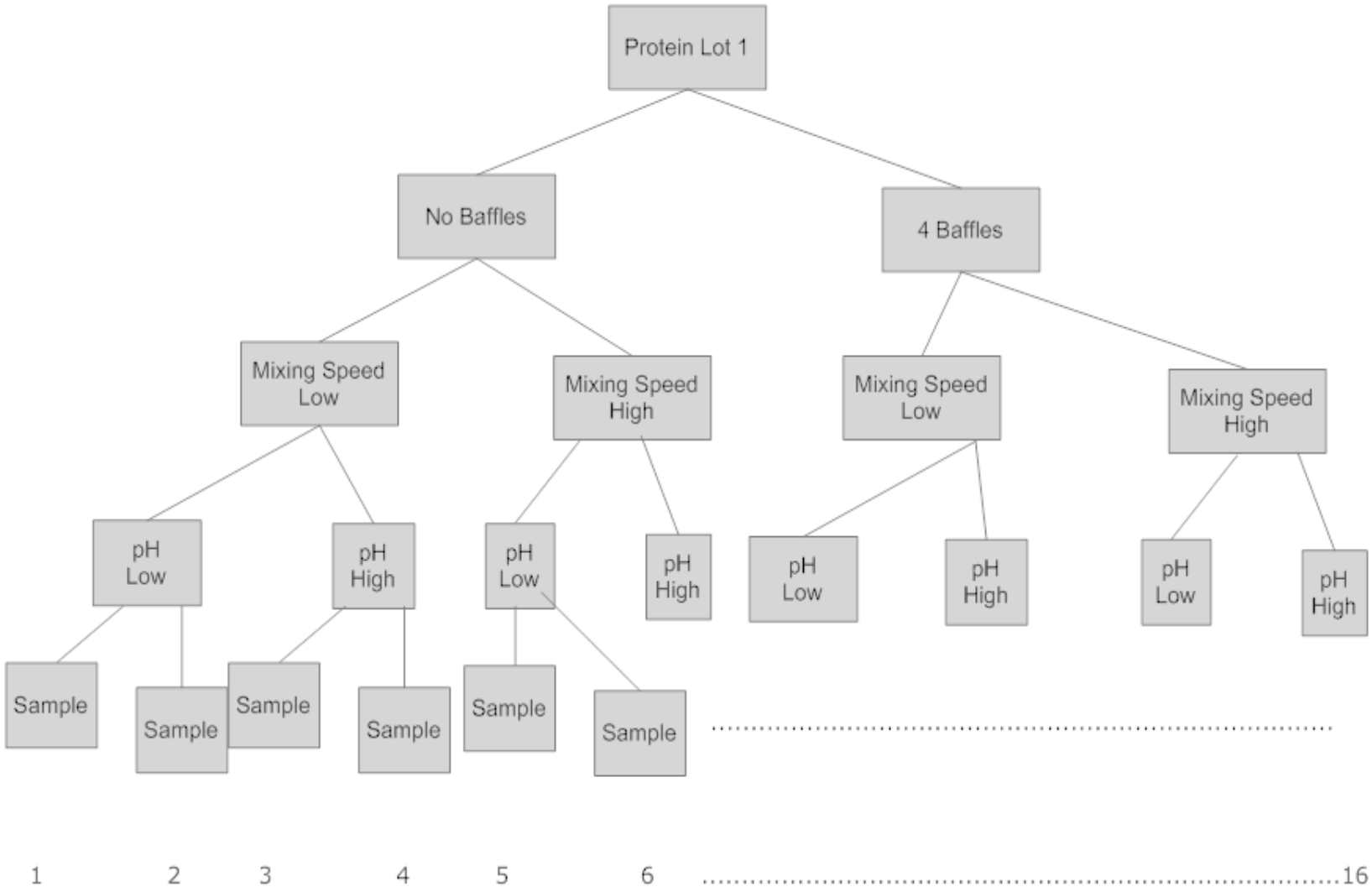
Components of Variance (COV: for mixing process)



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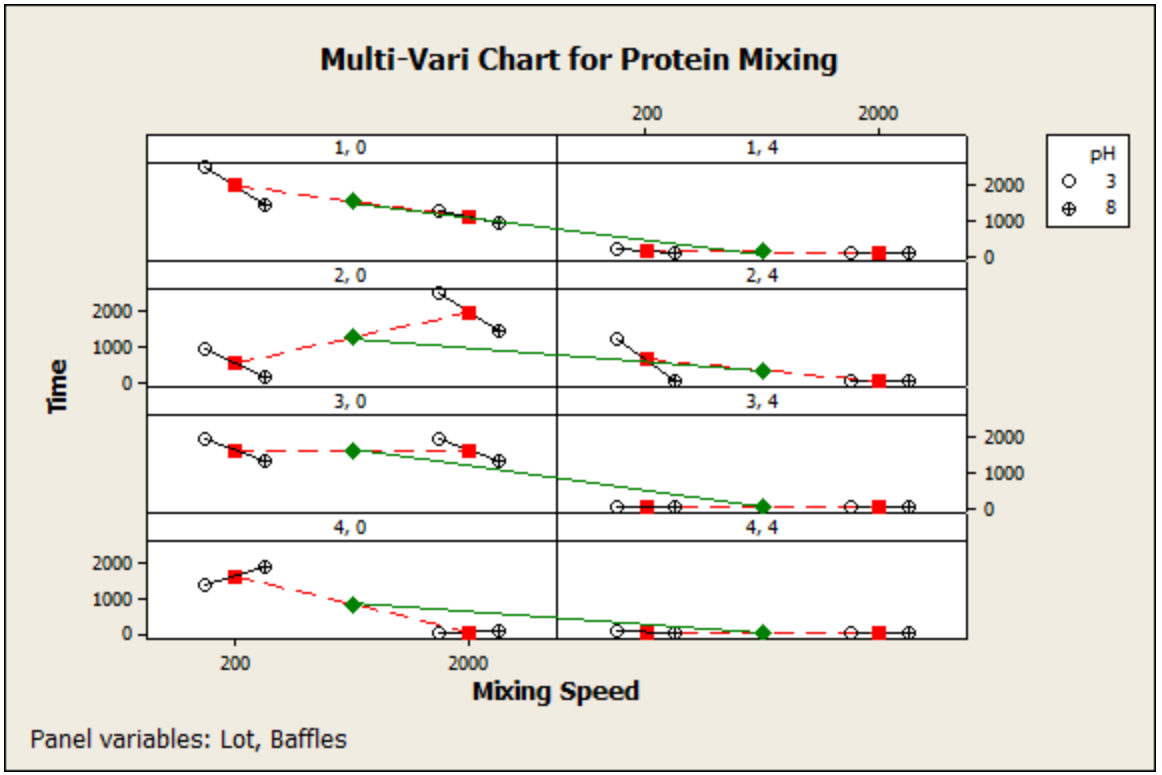
Components of Variance (COV)



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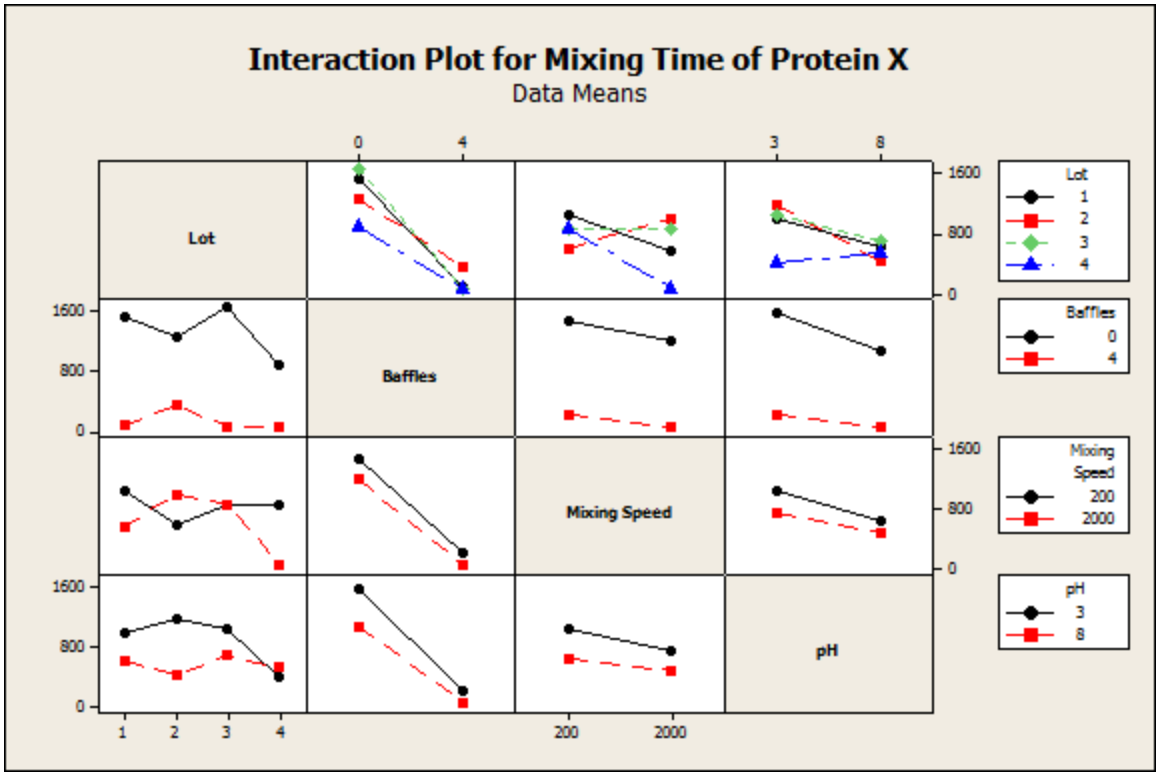
Components of Variance (COV)



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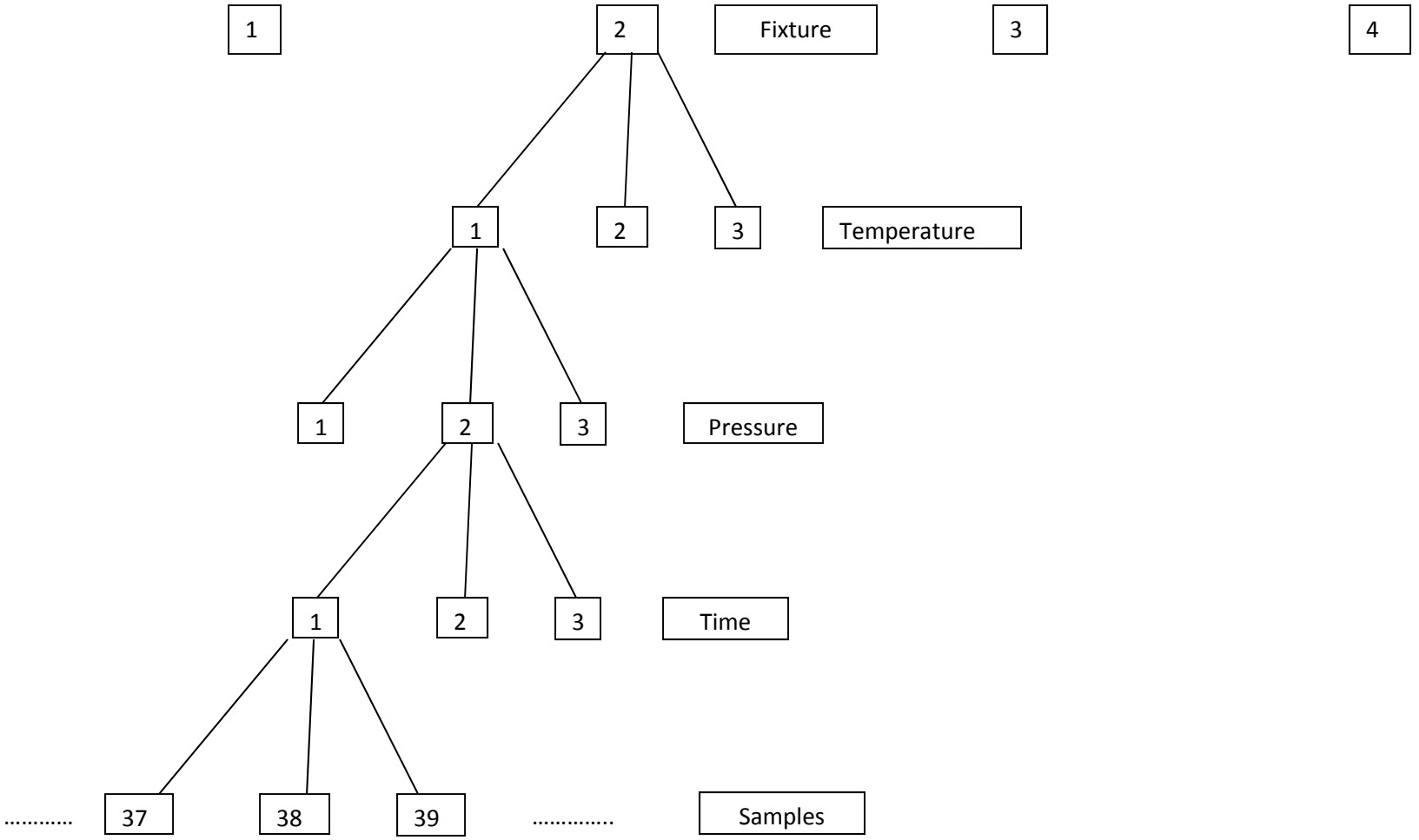
COV Tree Spray Coating a Medical Device



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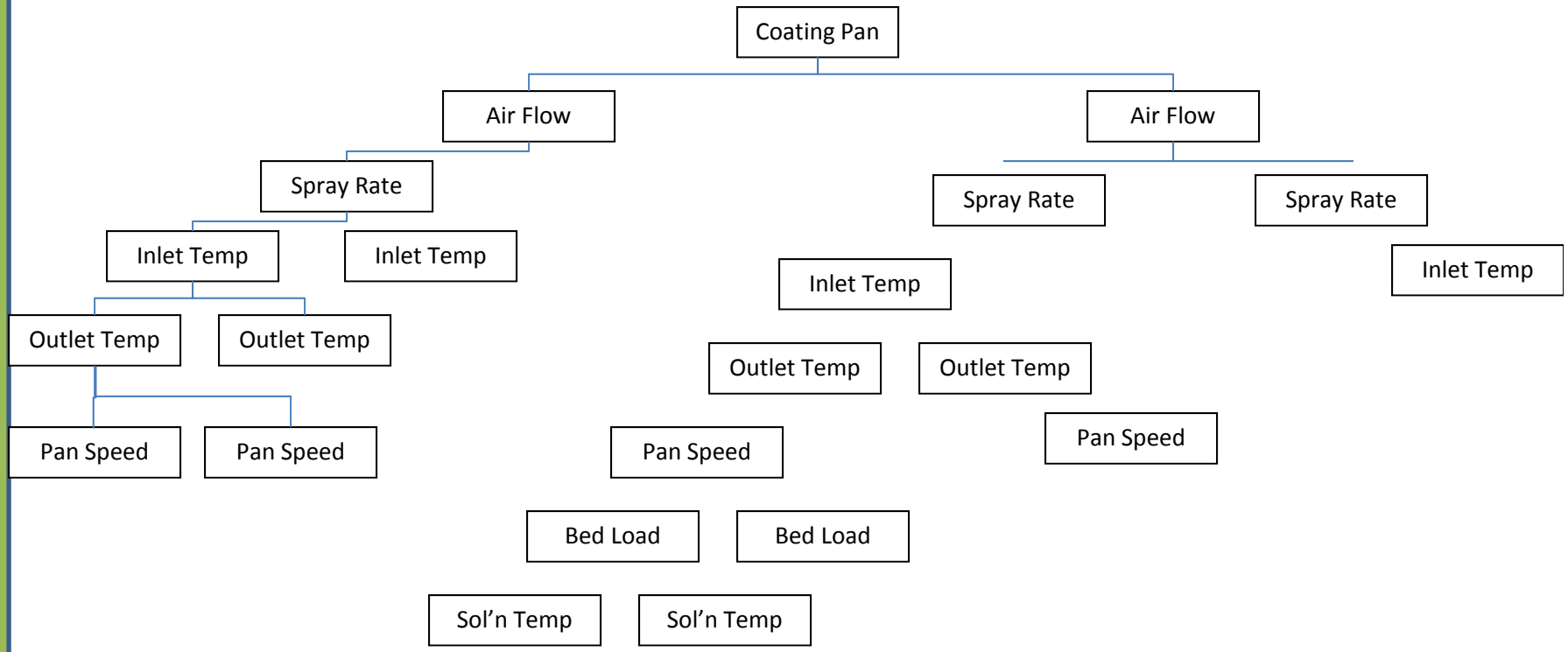
COV Tree for Coating Process



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Components of Variance (COV)

- A Gage R & R is a type of COV study, it is used to determine what percentage of the overall variation present is due to the testing method used to acquire the data from the sample. It gauges the Reproducibility and Repeatability of the method and the analyst.

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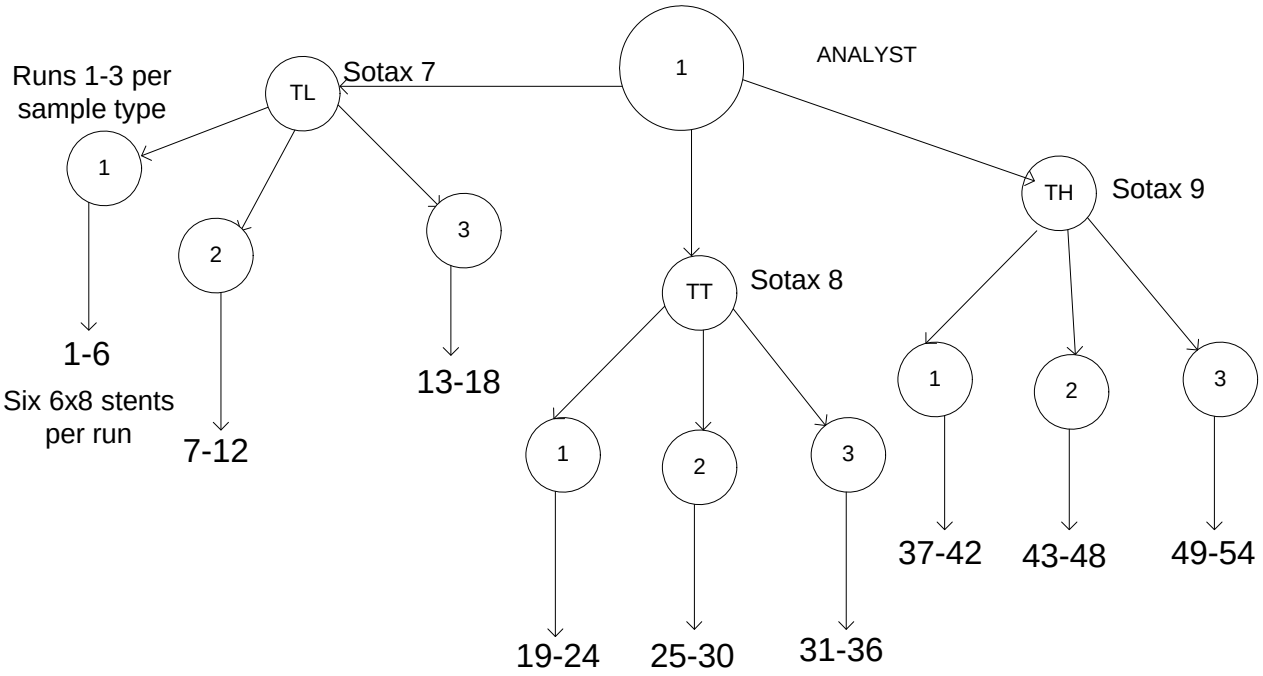
Components of Variance (COV)



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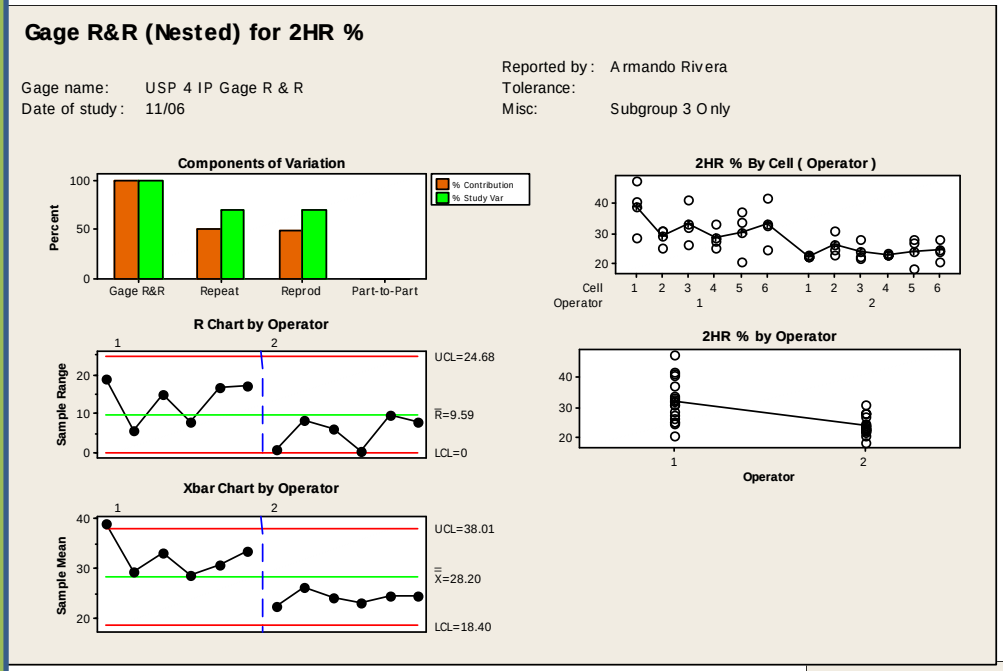
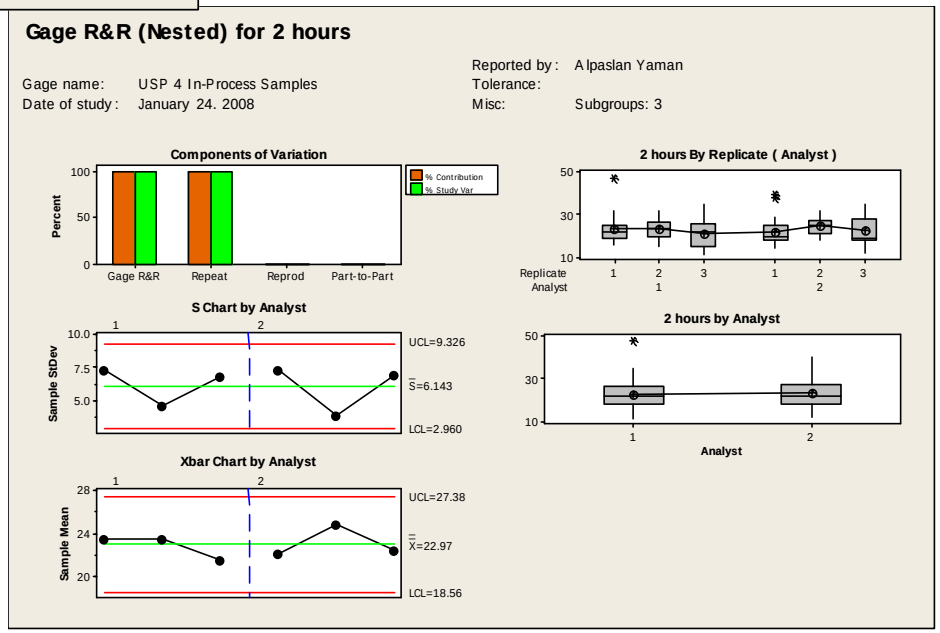


Below is the Final Gage R&R results which shows that the analyst no longer has a strong impact on the outcome of the test results. The variability associated with the analyst has been removed..

Above is the Original Gage R&R results showed that the analyst had a strong impact on the outcome of the test results. The analyst introduced variability into the results.



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Components of Variance (COV)

- A COV can be used as a cost savings tool to determine what factors should be studied in the experimental design (DOE) to yield the most information for the expended resources.

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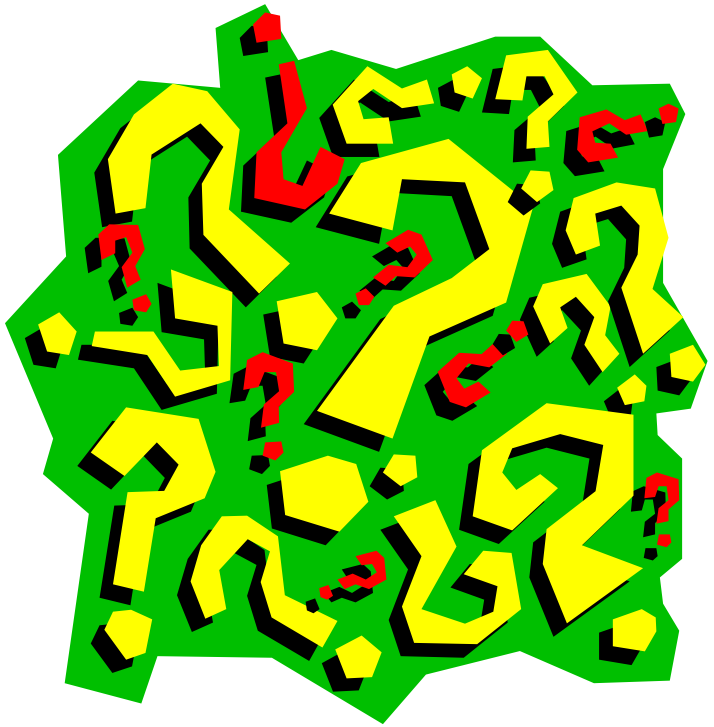
General Discussion & Questions



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