Sandia Data Challenge

UIUC FALL ‘25

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About us

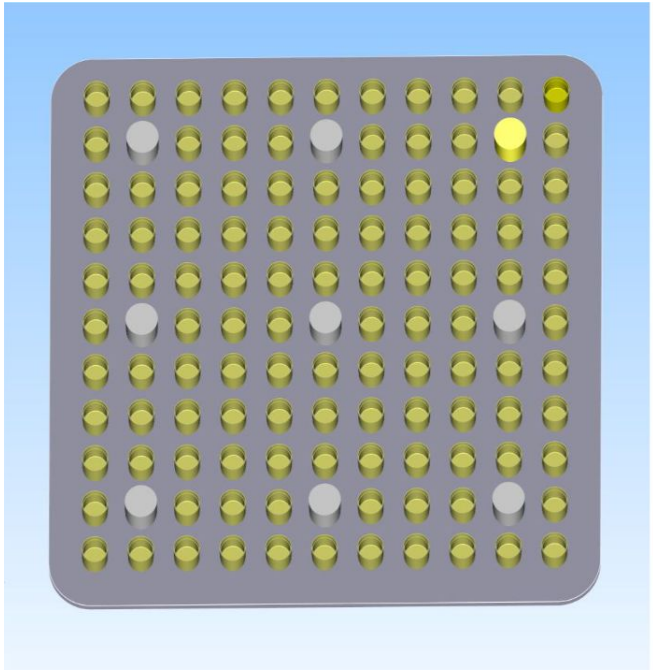
1. Data Problem
2. Preliminary Analysis
3. Method
4. Results
5. Conclusion

Data Problem

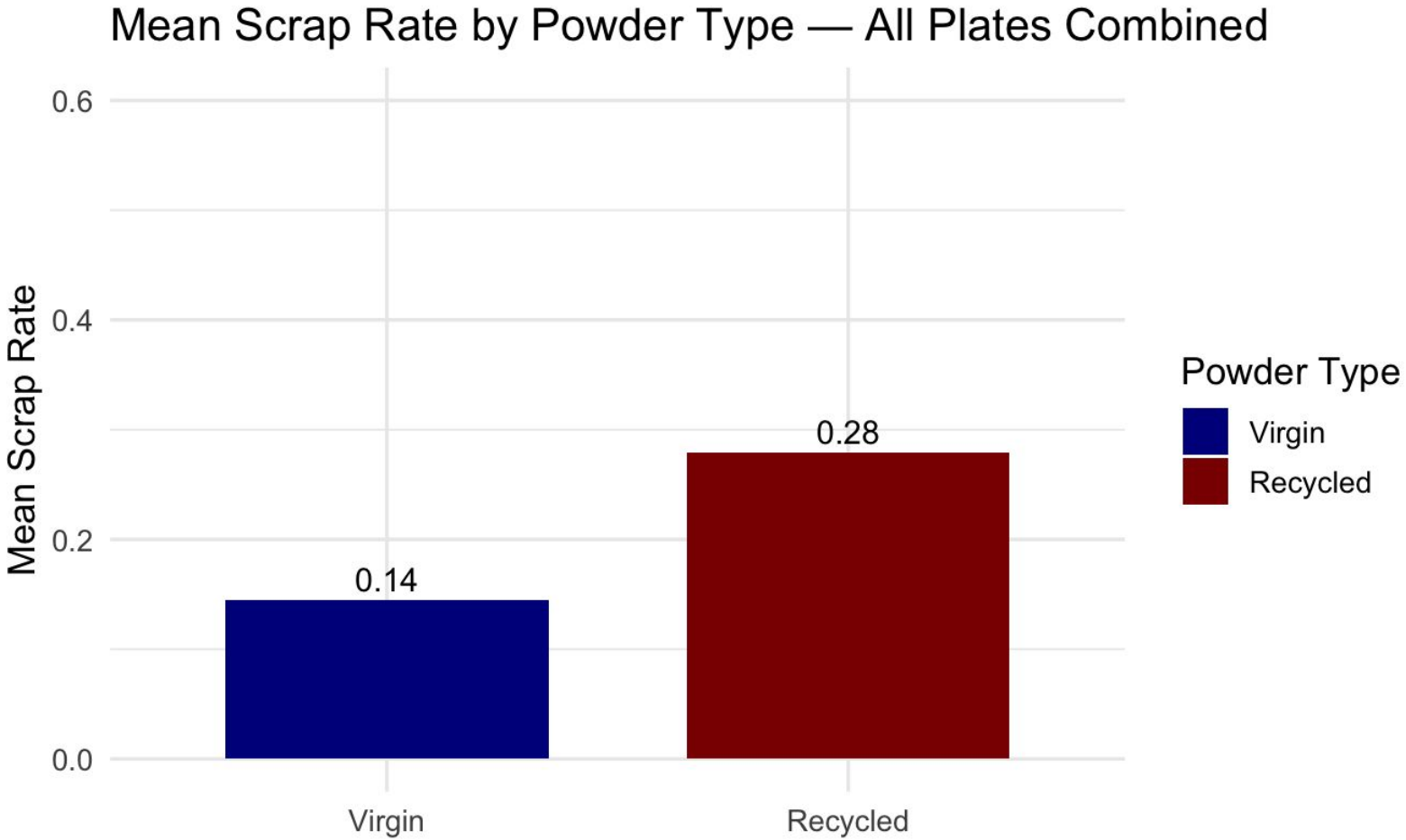
What combinations of build parameters minimizes the potential scrap rate/reduces the probability of scrapping?

Our team focused on four main parameters:

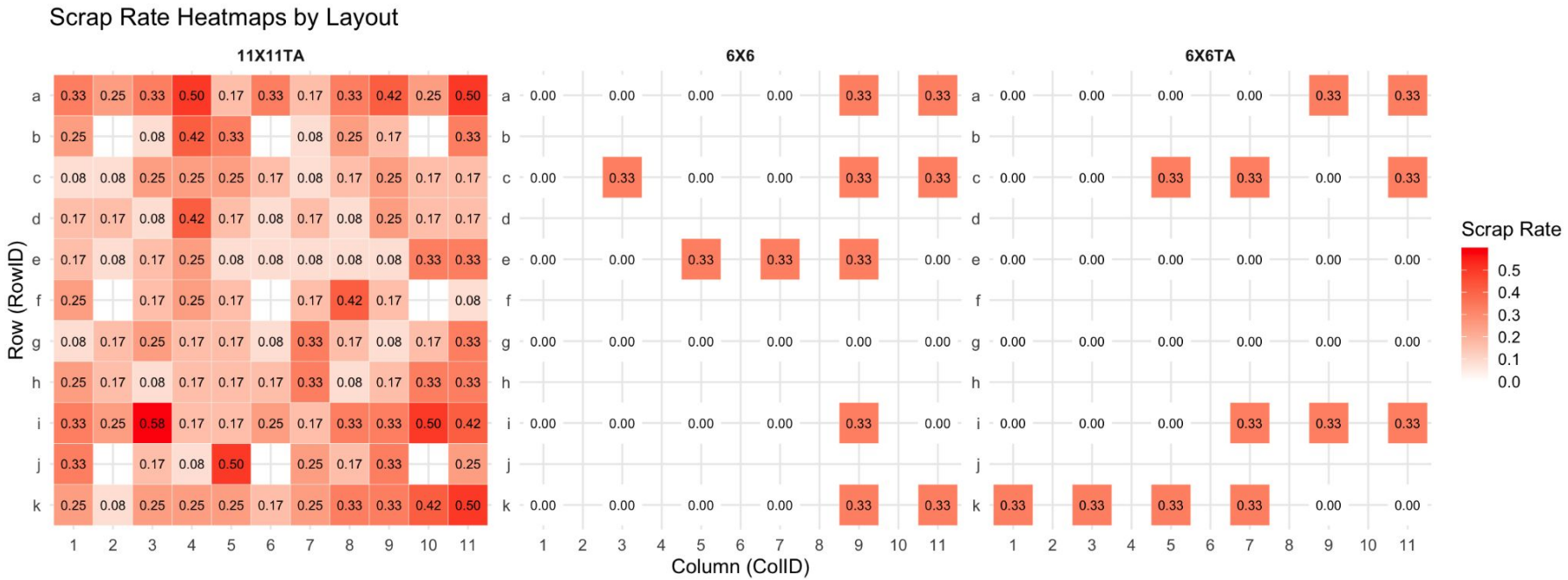
- Build Plate Layout
- AM Powder Type
- Location on the build plate
- Existence of test artifacts



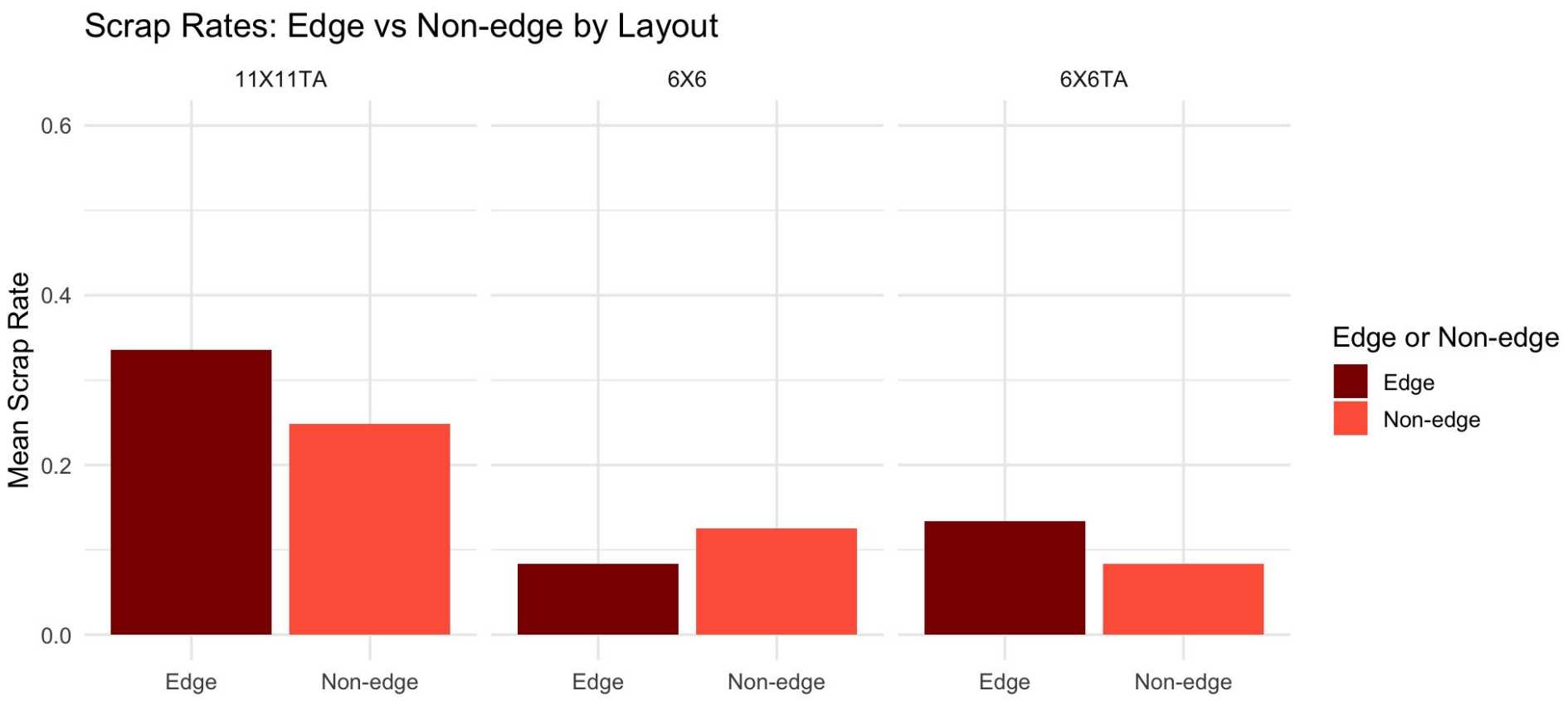
Preliminary Analysis



Preliminary Analysis Graphs



Preliminary Analysis Graphs



Preliminary Analysis Graphs

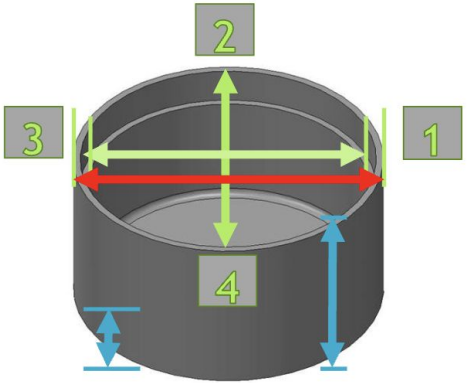
Method

Features:

- Layout
  - 6x6
  - 6x6 TA
  - 11x11 TA
- Powder
  - Virgin
  - Recycled
- Zone
  - Edge
  - Between
  - Center

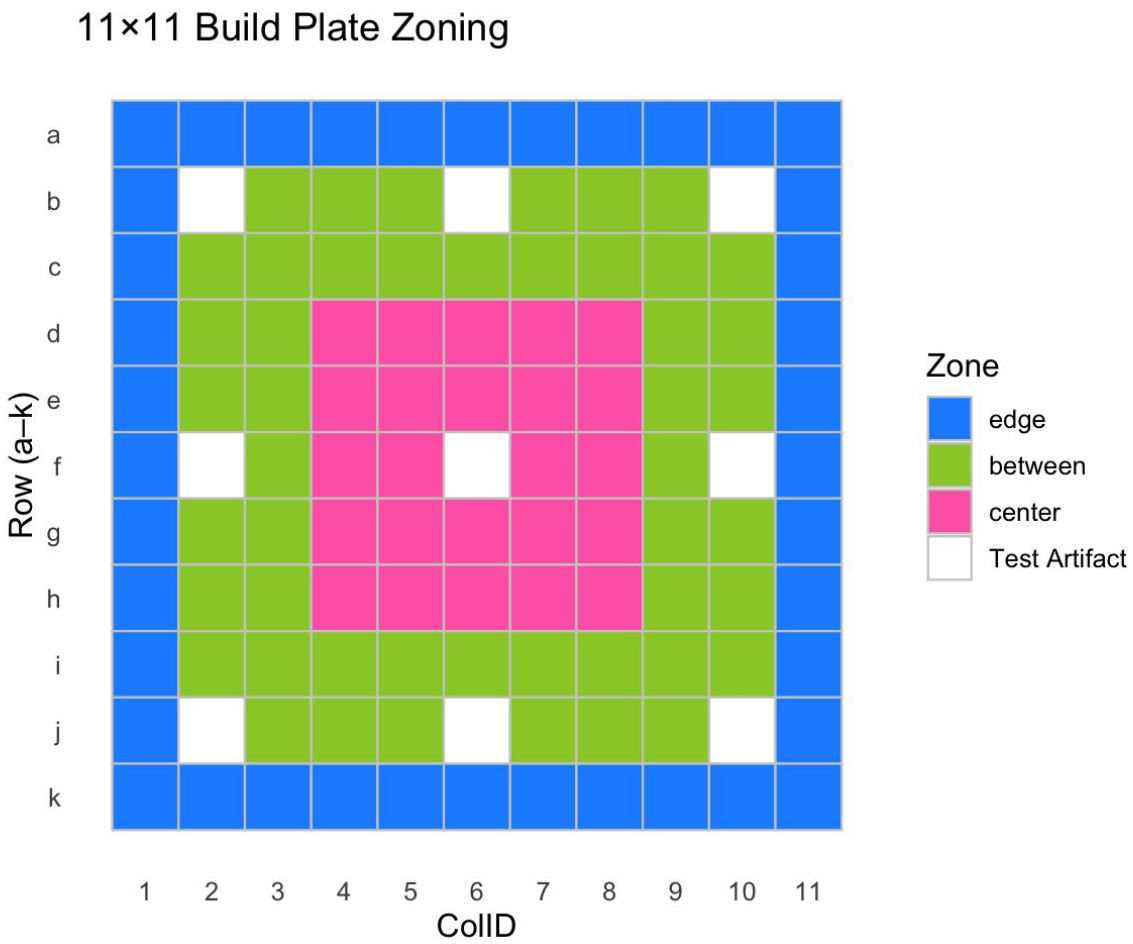
Response:

- Scrap
  - Each cup was determined to be a scrap (1) or not a scrap (0)



Responses (Form-Fit Geometry from CMM)	
Lip Interior Diameter	B3_DATUM_B_LOC [0.415”, 0.435”]
Lip Exterior Diameter	B3_REF_OD [0.445”, 0.469”]
Floor Height (with standoff material where applicable)	C1_LOC_INSIDE_PLN [0.049”, 0.069”]
Lip Height (with standoff material where applicable)	C4_LOC_TOP_PLN [0.261”, 0.281”]
Lip thickness (Measured at four locations around CUP lip)	B3_THICK1_WALL B3_THICK2_WALL B3_THICK3_WALL B3_THICK4_WALL [0.010”, 0.017”]

Method


11×11 Build Plate Zoning
Row (a–k)
a
b
c
d
e
f
g
h
i
j
k
1
2
3
4
5
6
7
8
9
10
11
ColID
Zone
edge
between
center
Test Artifact

Method

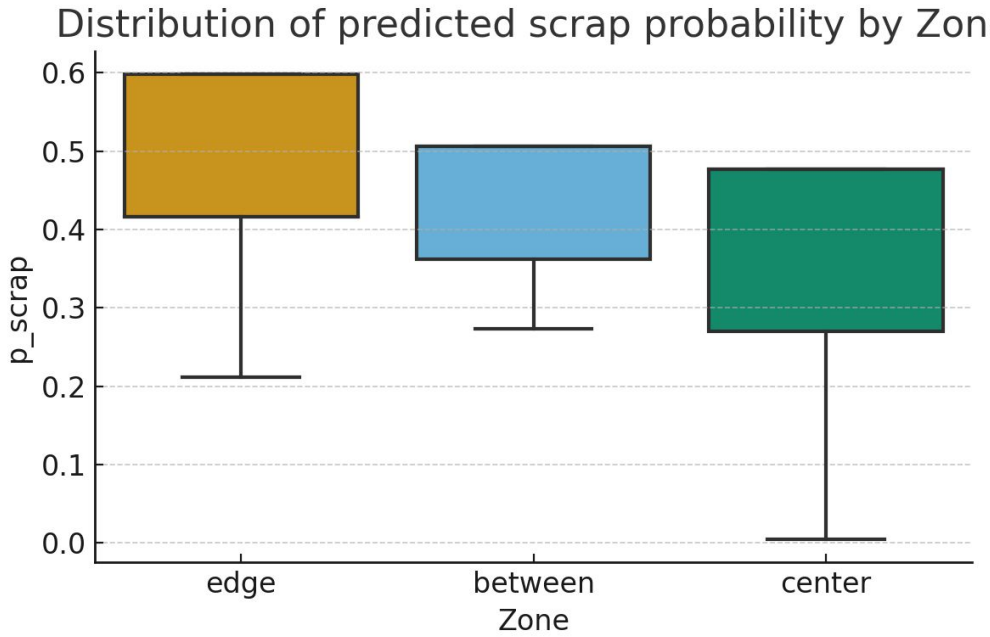
Model Goal: Learn which setups make scraps the least likely.

- Extreme Gradient Boosting (XGBoost)
  - Decision Tree based model
  - Feature importance insights, handles categorical data, imbalanced data

- Improvements made
  - Stratified and balanced class weights
  - Cross-Validation
  - Hyperparameter tuning

Results

Our model found:



	Layout	Powder	Zone	p_scrap
0	6X6TA	Virgin	center	0.004657
1	6X6	Virgin	edge	0.211493
2	11X11TA	Virgin	center	0.269927
3	6X6TA	Virgin	between	0.273675
4	6X6	Virgin	between	0.281289
5	6X6TA	Virgin	edge	0.319819
6	11X11TA	Virgin	between	0.362018
7	6X6	Virgin	center	0.385710
8	11X11TA	Virgin	edge	0.416335
9	11X11TA	Recycled	center	0.476952

Conclusion

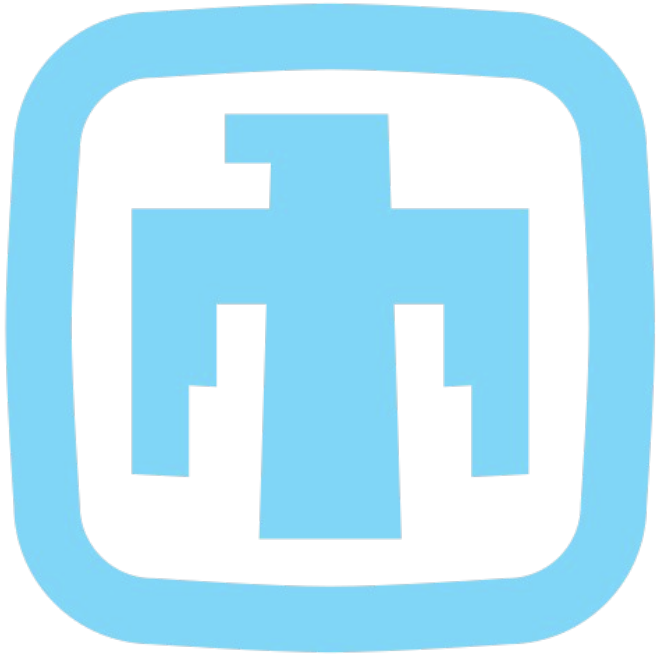
Our analysis highlights how our models can drive meaningful impact and address real-world challenges

Data Improvements for more impact:

- heat transfer analysis
- sample diversity
- increase in sample size

We aim to grow these skills further:

- model identification
- data organization



Thank You!