



FAMU-FSU
College of
Engineering

Plume Surface Interaction Scale Up Study **Team 518**

Leon, Santiago

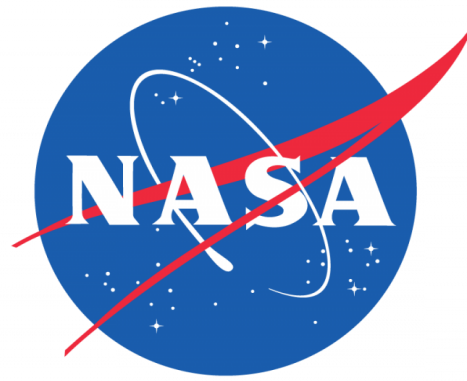
Meyaart, Nicolas

Porcelli, Marco

Sutherland Stephen

1/28/2024

Sponsors



Marvin Barnes



Dr. Manish
Mehta



Dr. Robert
Adams

Advisor



Dr. Unnikrishnan Nair



Team Members



Santiago
Leon



Nicolas
Meykaart



Marco
Porcelli



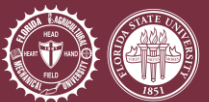
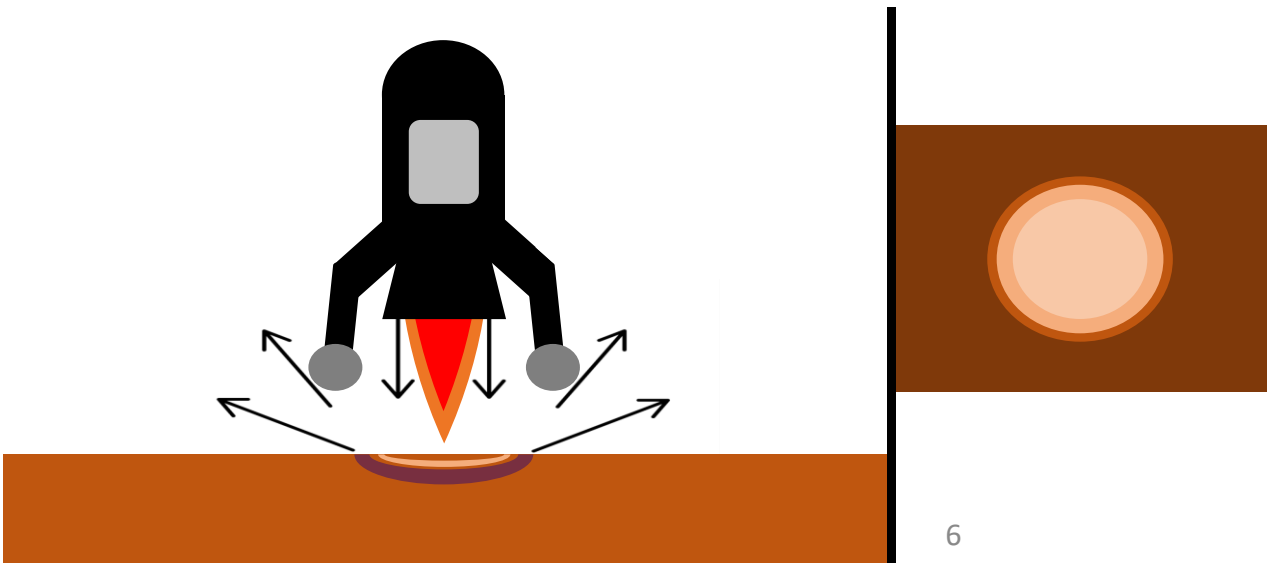
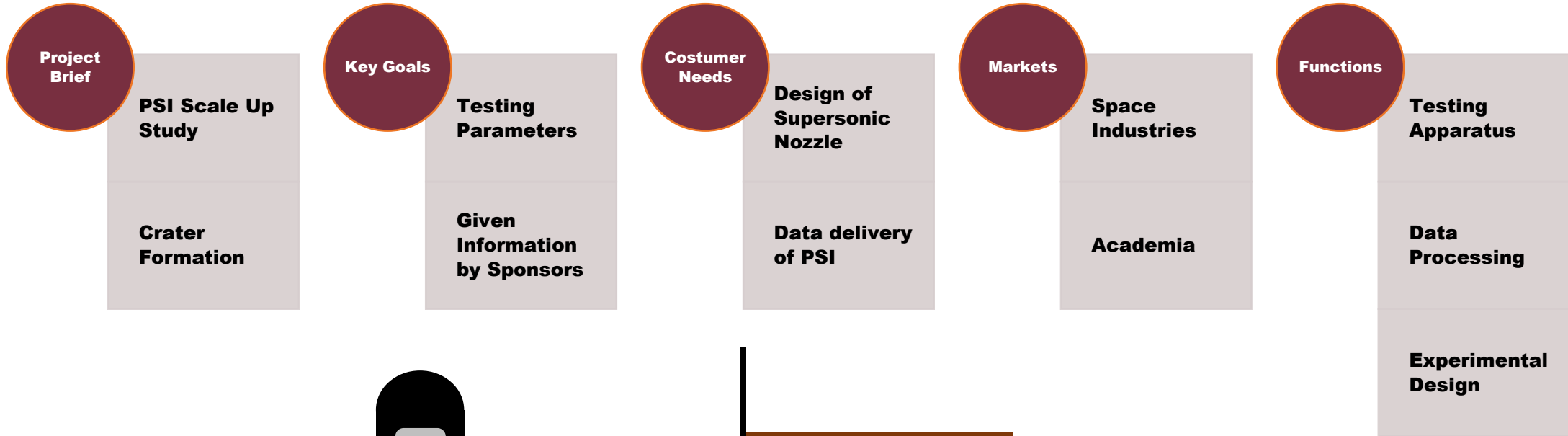
Stephen
Sutherland



Objective

The objective of this project is to design and implement a testing apparatus to study the effects of scaling on crater formation due to Plume Surface Interaction.

VDR 1

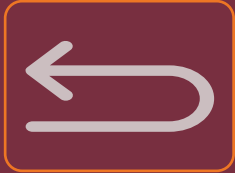


Targets and Metrics



Exit Jet Speed

- Must reach Mach 2



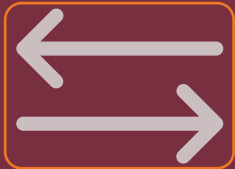
Enclosure Effect

- Minimize back pressure to 0 psi



Measure Crater width and depth

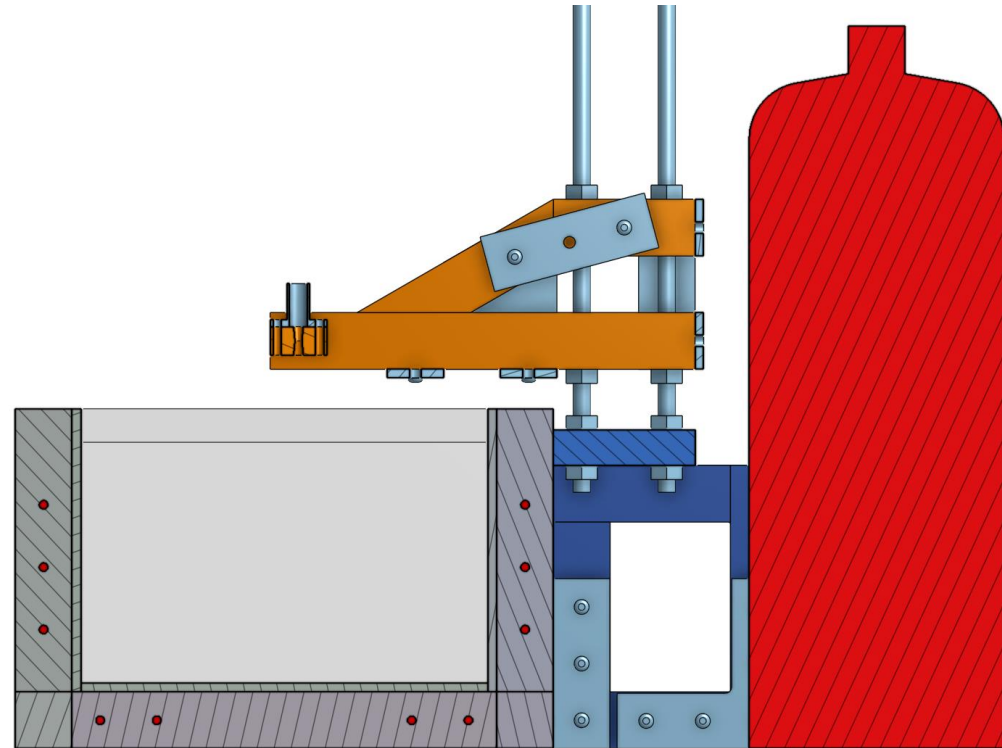
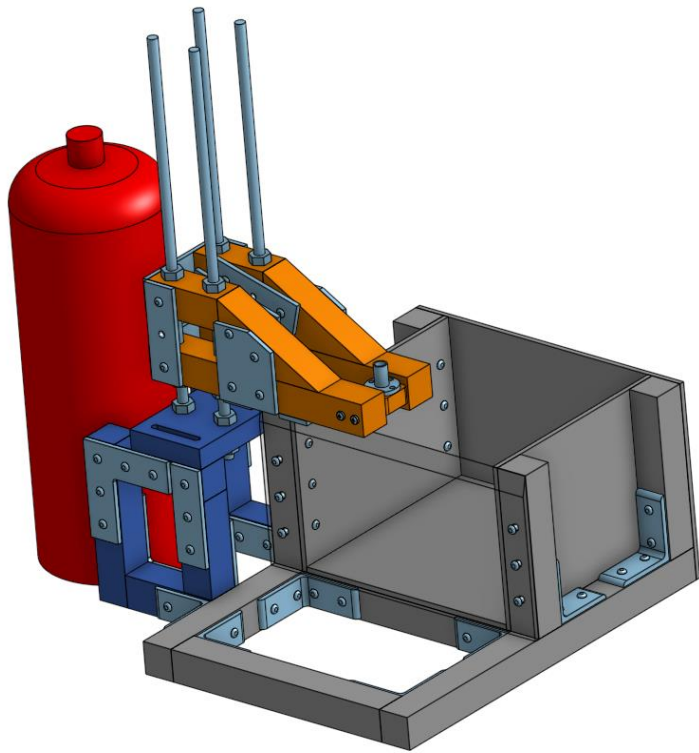
- Within 0.5% of total measurement



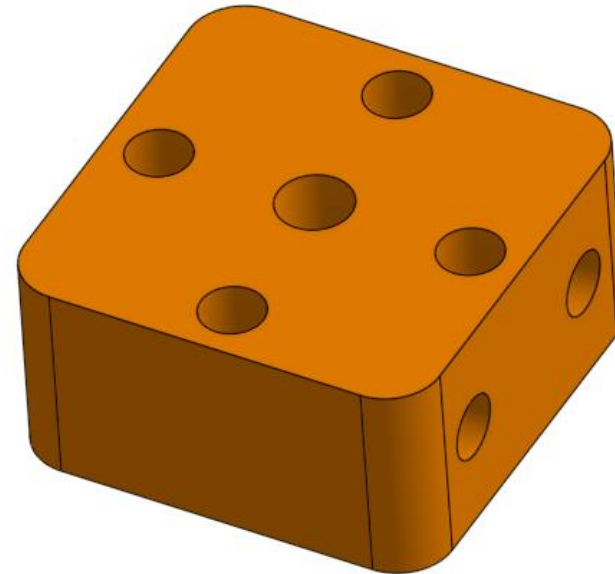
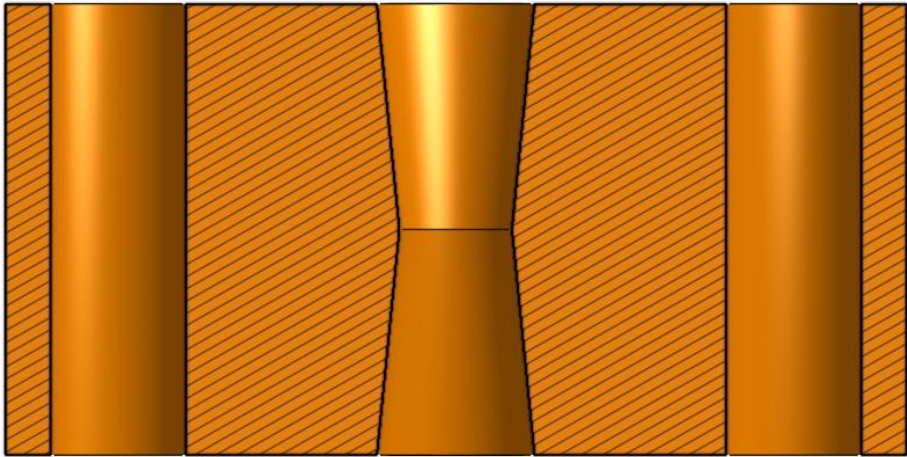
Correlate Data

- Create scaling laws that are accurate to 5%

CAD

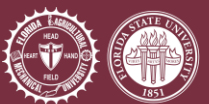


Nozzle Design



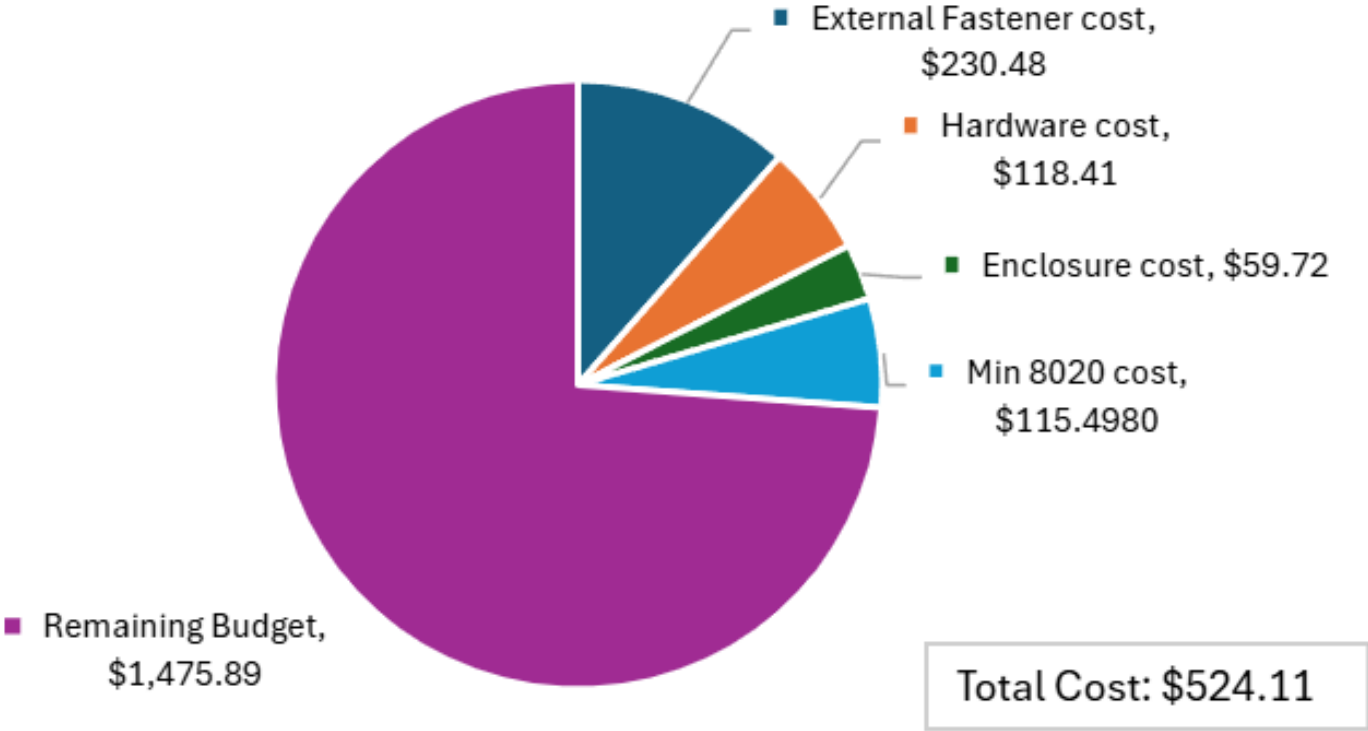
Bill of Materials

Category	Part Number/Vendor	Qty.	Description	Length (if applicable)	Unit cost	Cost
80/20 T-slotted Aluminum	40-4040-UL	2	>500 mm	500	\$0.0256	\$115.50
	40-4040-UL	2	>200 mm	200		
	40-4040-UL	2	>120 mm	120	Number of cuts:	
	40-4040-UL	2	>300 mm (one tapped end)	300	23	
	40-4040-UL	2	>160 mm	160	Price per cut:	
	40-4040-UL	2	>100 mm	100	\$2.79	
	40-4040-UL	3	>300 mm	300		
	40-4040-UL	4	>200 mm	200		
External Fasteners	40-4301	14	40 Series 4 Hole Bracket		\$6.43	\$90.02
	40-4306	12	40 Series 3 Hole Plate		\$6.58	\$78.96
	40-4331	2	40 Series 4 Hole 30 deg Plate		\$8.95	\$17.90
	40-4481	4	40 Series 5 Hole L Bracket		\$10.90	\$43.60
Hardware	95836A254	4	M5 x 50 mm screw			\$6.01
	1078N47	4	M12 x 1.75 mm Threaded rods		\$14.89	\$59.56
	90593A009	16	Nuts			\$8.62
	92095A238	132	M6 x 16 mm screw		\$7.37	\$44.22
	40-1961	132	Economy T nut		\$0.42	
Enclosure Materials	Amazon	1	Acrylic baffle			\$44.00
		1	Threaded rod board			
	Lowe's	-	Back wall			\$15.72
		-	Baseboard			
Miscellaneous	N/A	1	Air tank			\$0.00
		1	Camera gimbal			
	N/A	1	Machined nozzle			
					Total:	\$524.11

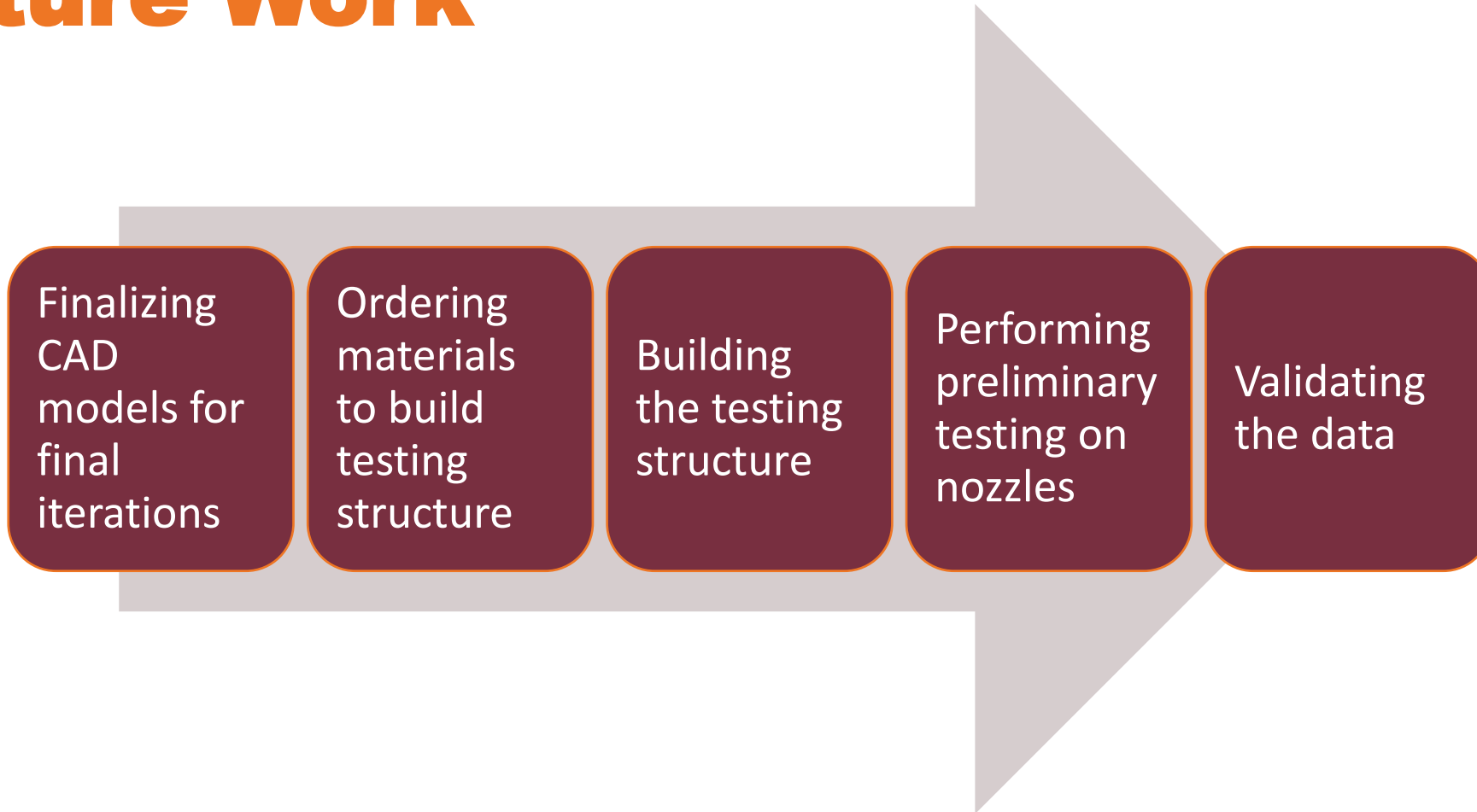


Budget

Cost Breakdown

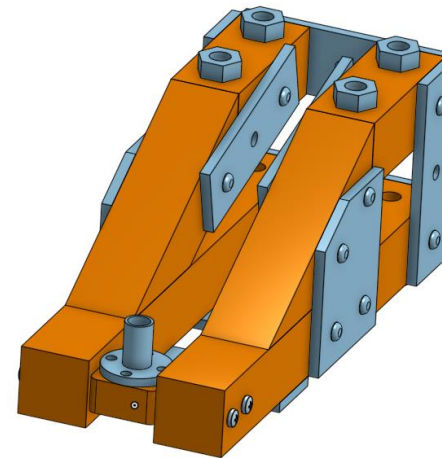
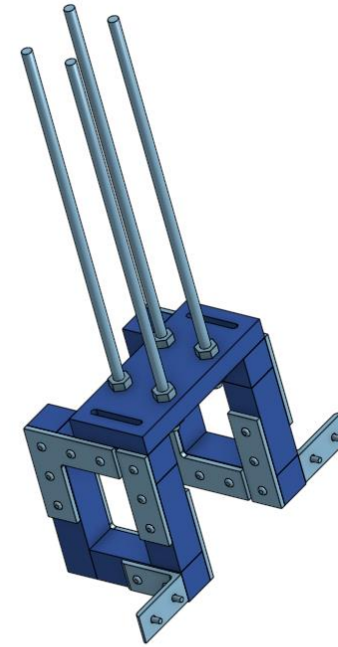
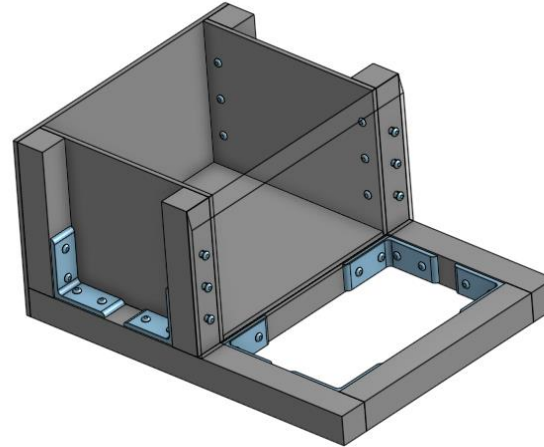


Future Work



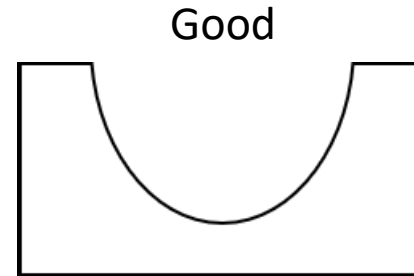
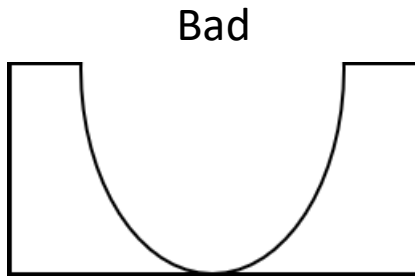
Building

- Order materials
- Manufacture nozzles
- Assemble the parts
 - Methodical approach
 - Build based on subassemblies



Preliminary Testing

- Validate Targets and Metrics
- Determine sand depth
 - Test with Jonas Gustavsson in an open sand bed



Data Aquisition

- Measure crater profile
- Use Matlab image processing to determine crater profile



Thank You!

