



# Design Review 6

## Team 506

### MeWee Table

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April 21, 2020

Alec Ellis, Kyle Innis, Anthony Muniz,  
Rieley O'Brien, Lauren Smith



# Team Introductions



**Alec Ellis**

Project Manager &  
Human Factors Engineer



**Kyle Innis**

Geometric Integration  
Engineer



**Anthony Muniz**

Mechanical Systems  
Engineer



**Rieley O'Brien**

Systems Engineer

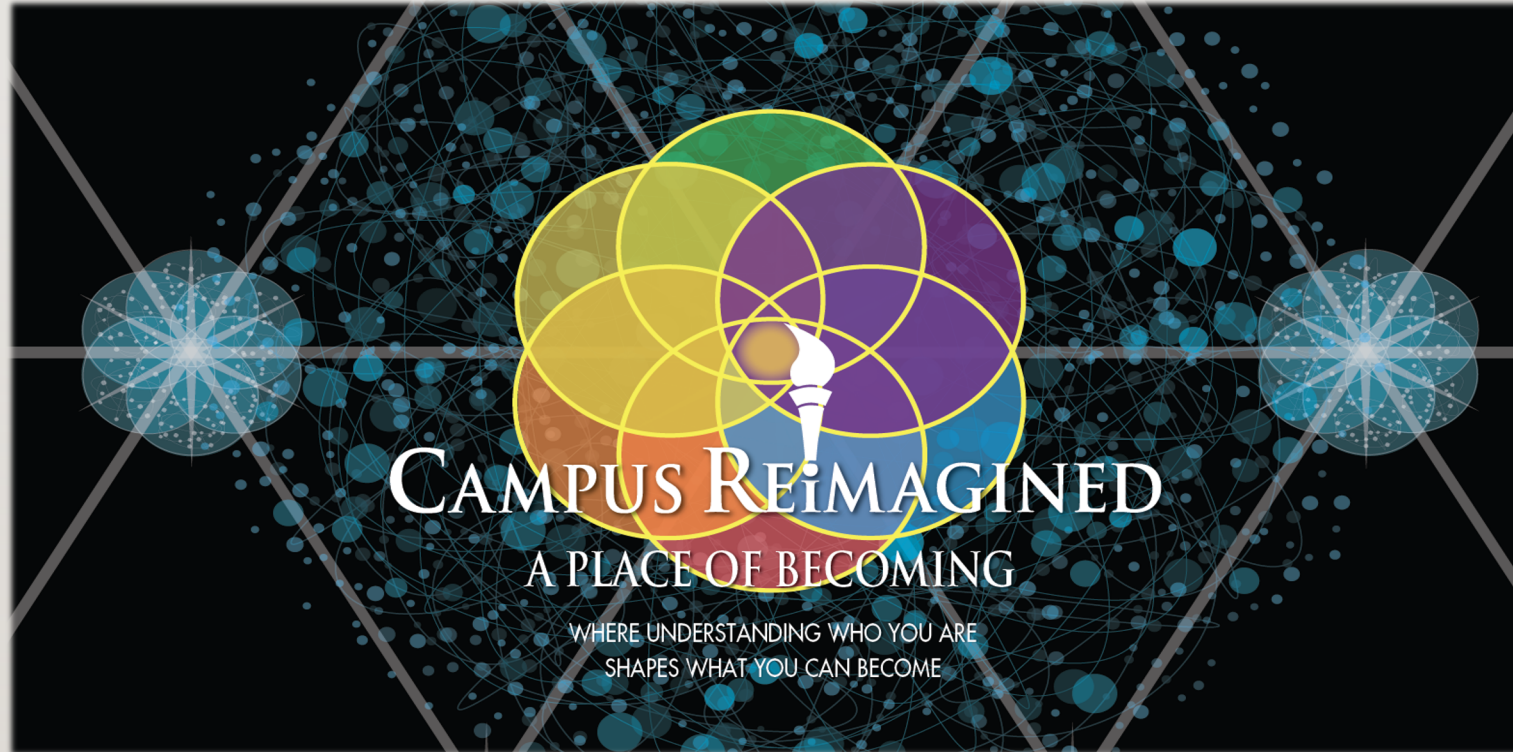


**Lauren Smith**

Materials Science  
Engineer



# Sponsor



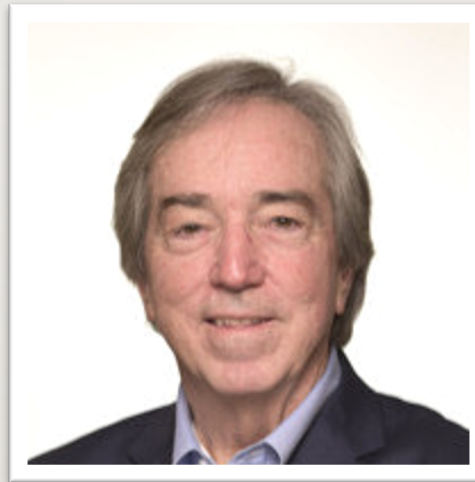
Alec Ellis



# Advisor, Visionary & Point of Contact



**Dr. Patrick Hollis**  
FAMU-FSU College of  
Engineering



**Mr. Bill Lindner**  
Campus Reimagined (CRI)



**Mr. Peter Butler**  
Campus Reimagined (CRI)

Alec Ellis



# Everyone's Problem



Alec Ellis



# Everyone's Problem



Alec Ellis





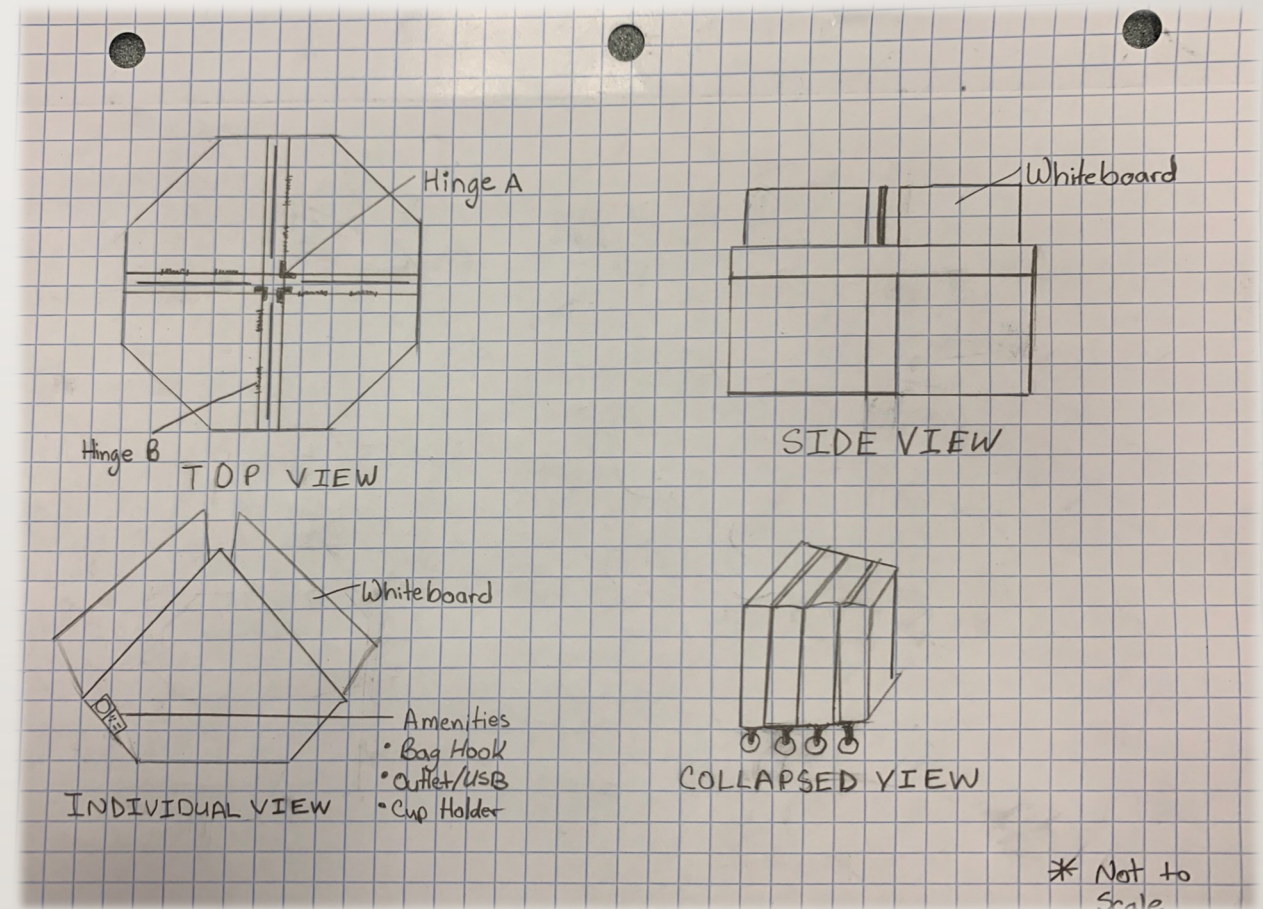
# Objective

- To design and build a multipurpose table allowing for collaborative work and individual work which will enable better utilization of space in university libraries

Alec Ellis

# Initial Design Process

- Functional Decomposition
- Research
- Targets and Metrics
- Concept Generation
  - Morphological Chart
  - Biomimicry
  - Medium-High Fidelity
- Concept Selection
  - Binary Pairwise
  - House of Quality
  - Pugh Chart
  - Analytical Hierarchy Process



Alec Ellis



# Why the Concept Works

- A typical library setup includes many full size, open layout tables
  - Difficult to transport (if transportable at all)
  - Difficult to store away
- Many university libraries are multipurpose
  - Space is primarily used for studying or tutoring
  - In the case of the library hosting an event, foldable tables allow for either storage or rearrangement



Alec Ellis

# Why the Concept Works

- A folding table is an ideal solution to transform library space
  - Standard folding tables are easy to store away and transport
  - Spatial configuration is less limited by total library size
    - Arrangement
    - Number of tables utilized
  - Much like the cart, wheels added directly to the table further enable easy transport



Alec Ellis



# Why the Concept Works

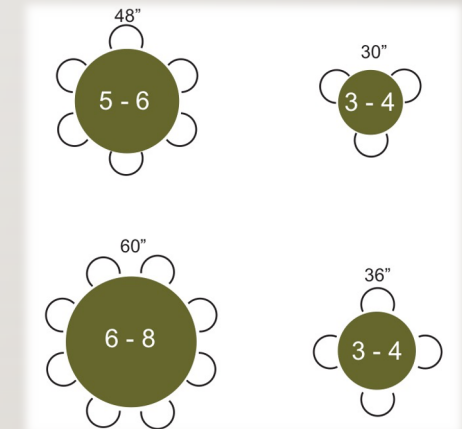
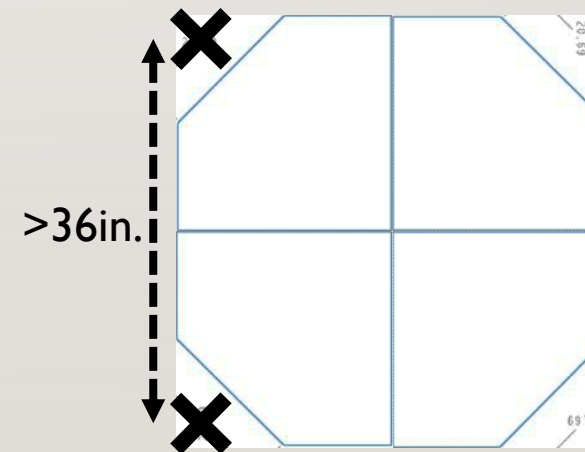
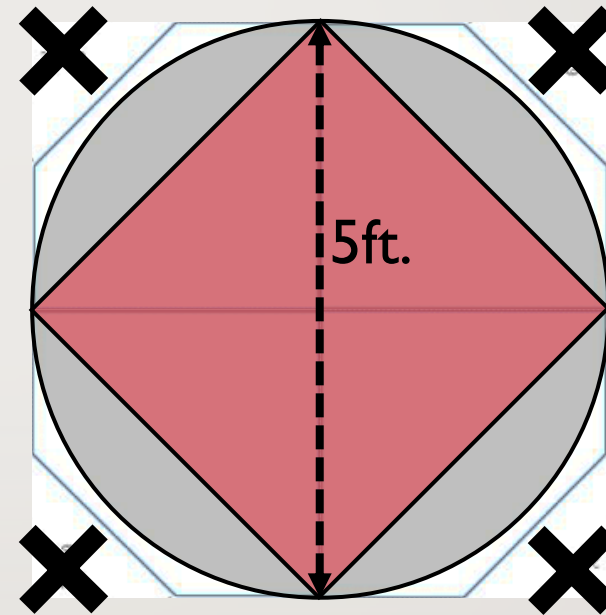
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Alec Ellis

# The Human Factor

- The imperfect octagonal tabletop shape provides more individual working space per seat
  - Larger area than a square or circle of the same diameter
  - Shape allows for an ideal distance across the table person to person, between 5-6ft. (60-72in.)
  - Side-to-side space is also considered with over 36in. between individuals
    - Ideal is 24in. of lateral space occupied per person
  - Just under 6 ft.<sup>2</sup> per tabletop section

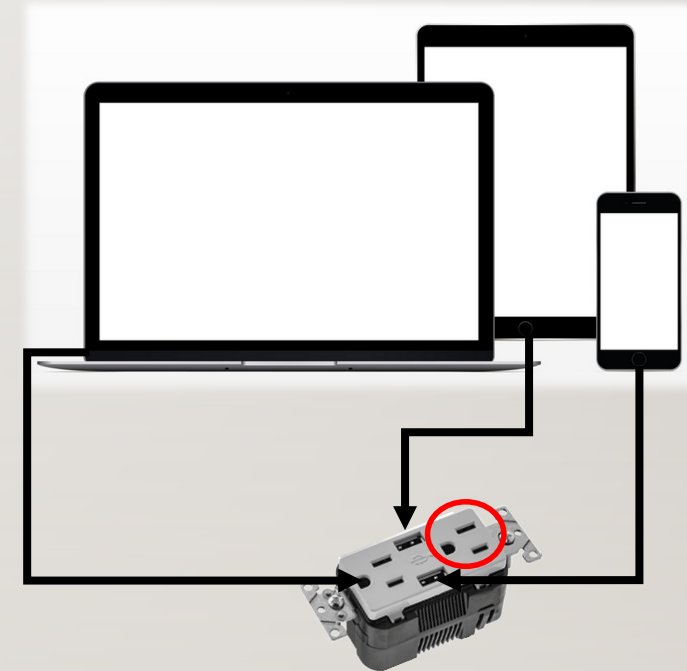


Alec Ellis



# The Human Factor

- Integrated whiteboard maximizes use of divided workspace
- Industry standard desk height is 29in.
  - Our table height at 32.5in. is a compromise between:
    - Familiarity
    - Accessibility (wheels, tabletop space)
  - Will be best suited with use of adjustable height library chairs
- 2-outlet, 2-USB power integration provides an efficient workspace for the modern, technology-connected student



Alec Ellis

# Design

- Retractable whiteboard that's default state is upward, separating people
- Legs will lock open at 90 degrees for ease of table setup
- Whiteboards will lock in the down position and be supported by a gas strut for raising with less effort

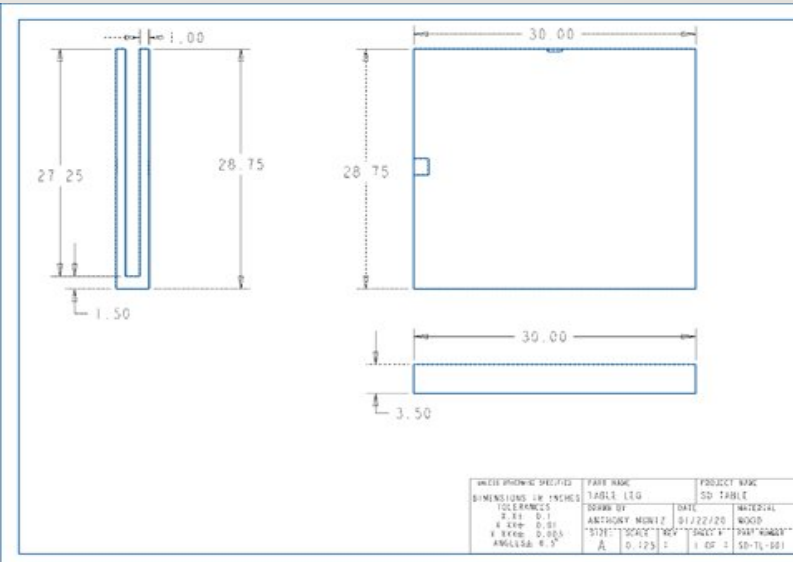
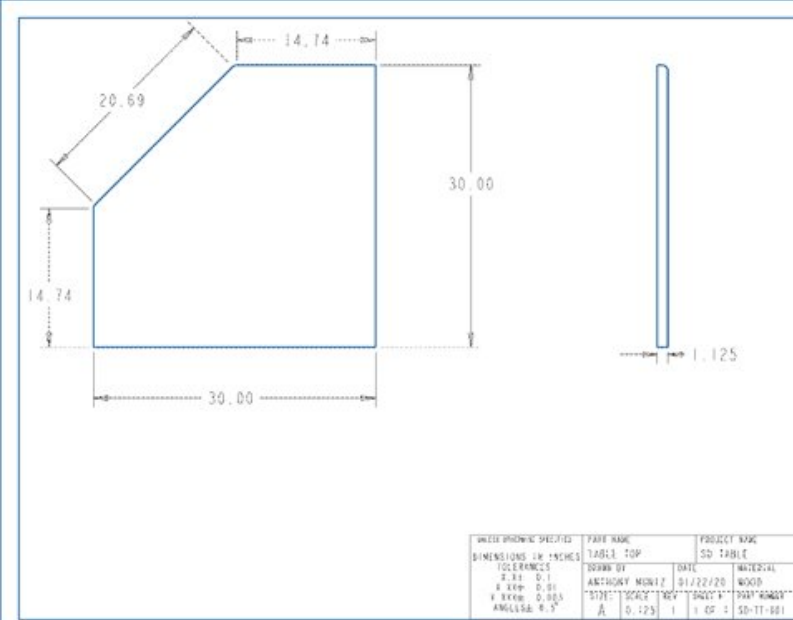


Kyle Innis



# Design Dimensions

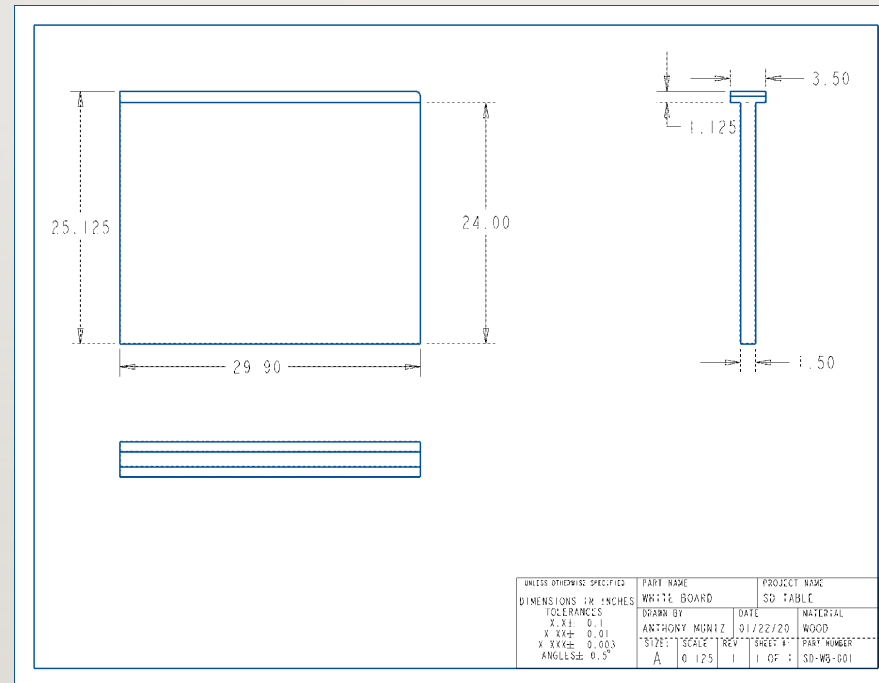
- The size of the tabletop was determined by dividing a rectangular table into 4 parts with the table being 5ft. wide in total
- Average width of a workstation table is 30in.
- The chamfered corner spreads people apart more for extra space
- We measured various table's legs to find the best height for the average person
- The average height of desk is 29-30in.
- Interior is hollow for the whiteboards to fit



Kyle Innis

# Design Dimensions

- The height of the whiteboard is 24in. which ensures that each person is separated from each other
- The total height of the table is 4.54ft. with the whiteboard up
- The T shape allows the whiteboard to fit within the hollowed legs

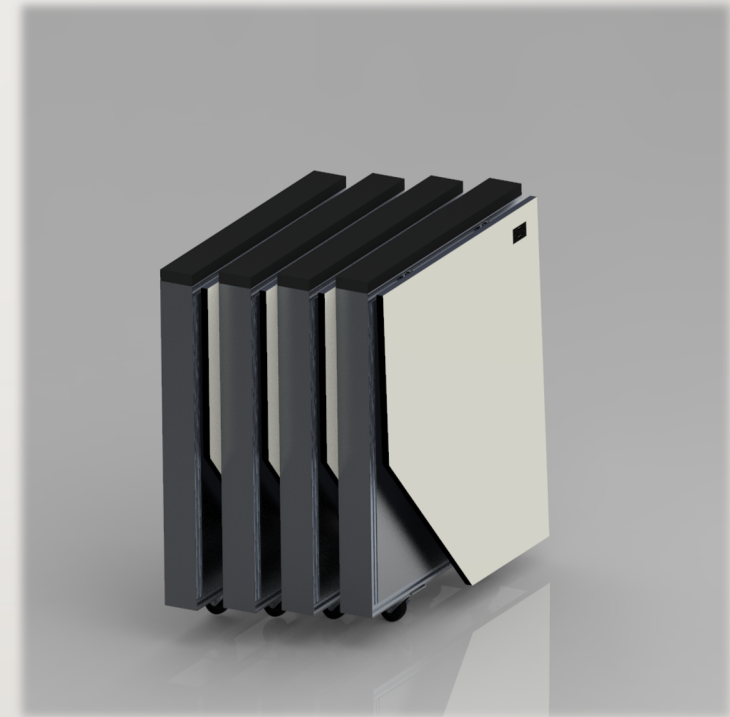
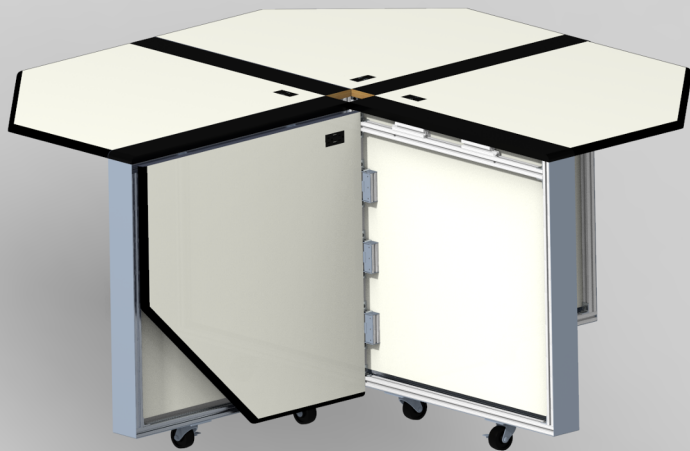


Kyle Innis



# Design Specifications

- Tabletops will be locked at 90 degrees when in use
- Can fold against the legs of the table to be collapsed and cover 29in.

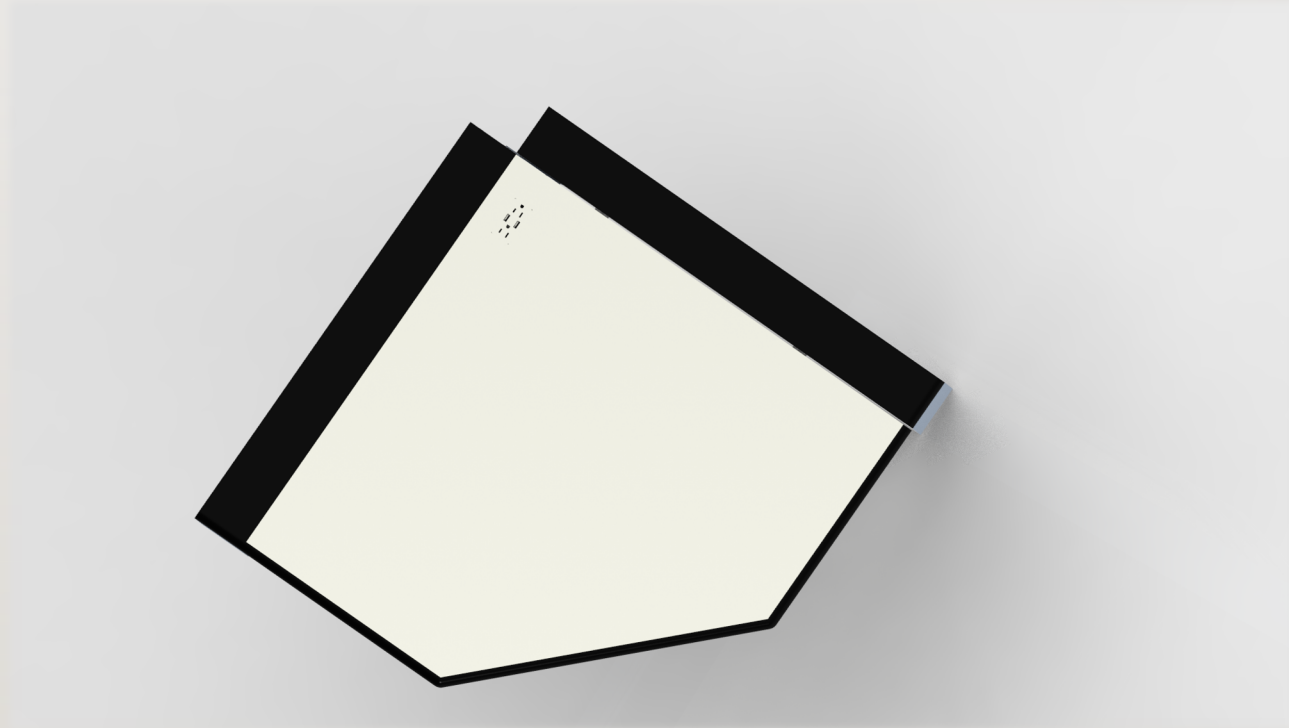


- Table folds to roughly 30x30x20in. which makes it easier to storage
- Equipped with a total of 8 castor wheels for transport having 2 wheels per leg near the end and leading edge
- Wheels are 2.36in. diameter

Kyle Innis

# Design Specifications

- The surface area of the tabletops and 2 whiteboards are 5.45ft.<sup>2</sup> and 4.80 ft.<sup>2</sup> respectively
- Each section has a total of 10.25 ft.<sup>2</sup> workspace for a person

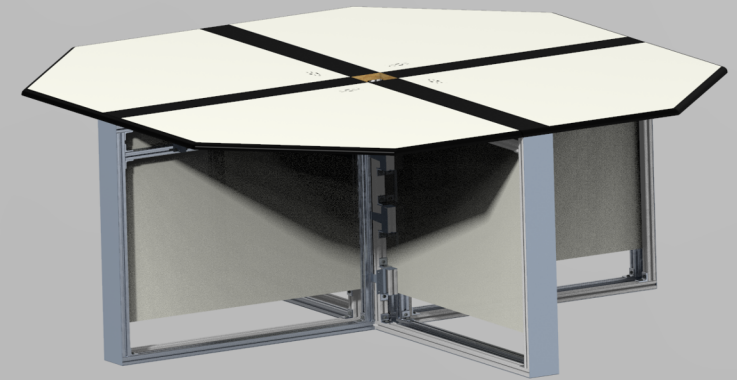


Kyle Innis



# Design Specifications

- The volume of the table is 113.5 ft.<sup>3</sup> when expanded and 10.44 ft<sup>3</sup> when collapsed
- Gensler research states that they are trying to allow studying to be available in more areas  
Gensler Research Catalogue Volume 1 (2014)
- Our table satisfies this by being mobile, collapsible, and accommodable



Kyle Innis

# Design

1



2



3

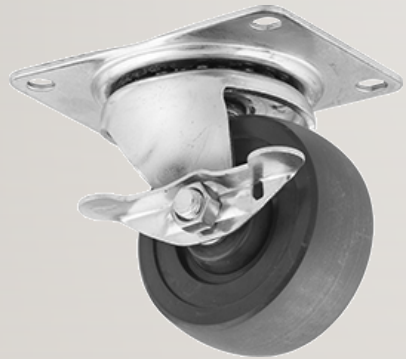


Kyle Innis

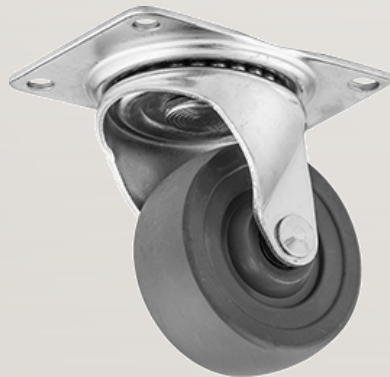


# Caster Wheel Selection

- Rubber swivel casters are semi-shock-absorbing, provide good traction on smooth or rough surfaces, and are non-marking
- Casters **with wheel brake** - apply pressure to the wheel to stop movement with a press of the foot lock



- There will be (4) regular swivel casters, and (4) swivel wheels with the brake

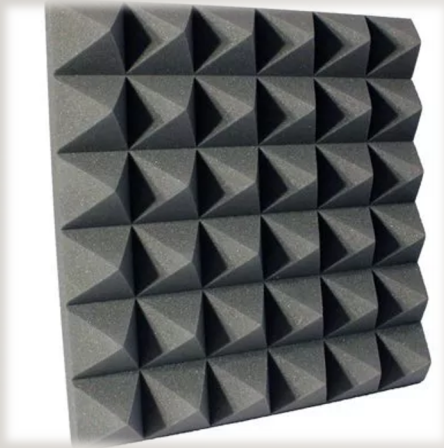


- This is necessary to lock the table in place and prevent any motion

Lauren Smith

# Divider Selection

Decision on what to make the dividers between each section



Alternative considered:

- **Sound dampening dividers**
  - Reduces noise across the table, but would not help with background noises

Final Selection:

- **Whiteboard dividers**
  - Extra writing space
  - Promotes group work
  - Interesting feature



Lauren Smith

# Frame Selection

Strong, light material

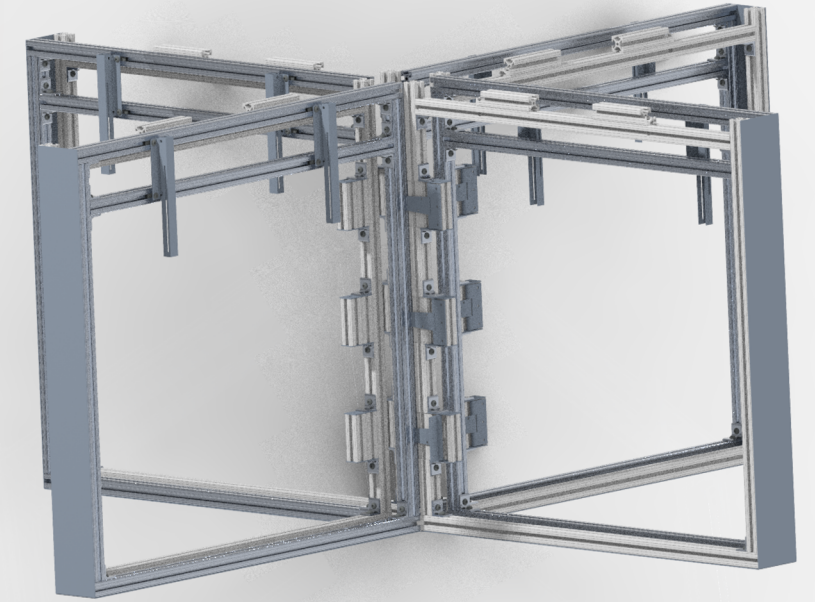
## 80/20 Framing Extrusion



- Provides T-Slot aluminum profiles with channels used to connect other bars and parts
- Used to create custom solutions
- Adjustments and assembly are fast, no welding required

### Alternatives Considered:

- Aluminum bar stock
  - Too heavy for the application
- Aluminum tubing
  - Time consuming and difficult to weld a frame symmetrically



Lauren Smith



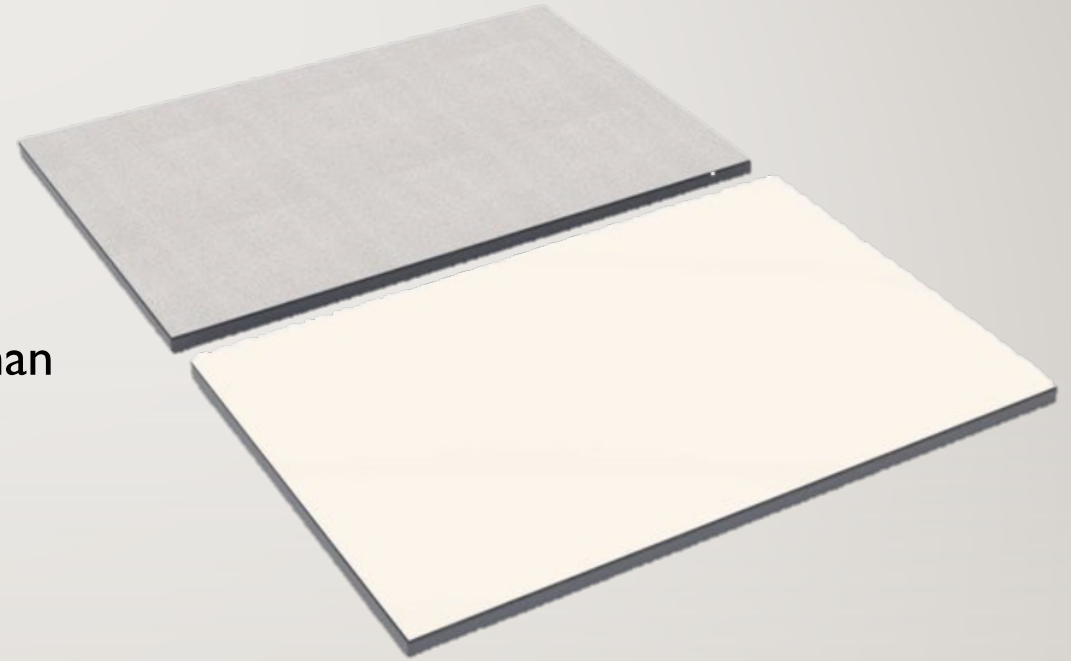
# Tabletop Selection

## MDF Melamine Board

- The density of MDF accepts hinges and screws better than more porous wood, creating a stronger hold
- Priced lower than other wood species
- Coated, glossy exterior; cut edges appear smooth

## Alternatives Considered:

- High Density Polyethylene
  - Very expensive; Custom-order, meaning long delivery period
- Polycarbonate
  - Extremely durable, glossy exterior, and high tensile strength, but too expensive.



Lauren Smith

# Budget Report

Product Description	Quantity	Price (\$)
Aluminum T-Slotted Framing Extrusion (97 in.)	13	337.87
2-Hole Inside Corner Bracket	90	281.70
T-Nuts (Package Qty - 15)	14	85.82
Melamine Board (0.75x49x100 in.)	2	61.96
Multi-Position Fold Away Shelf Bracket	8	188.56
Straight Blade Receptacle with 2-USB Ports	4	144.28
Strap Hinge	12	31.32
Gas Spring 5/16 in.	4	108.40
T-slotted Framing Rail-to-Panel Gliders	16	47.68
Polyethylene Plastic Trim (10 ft.)	2	13.00
Cart Smart Caster (2.5 in. swivel with brake)	4	44.60
Cart Smart Caster (2.5 in. swivel)	4	32.20
	<b>Total</b>	<b>1377.39</b>

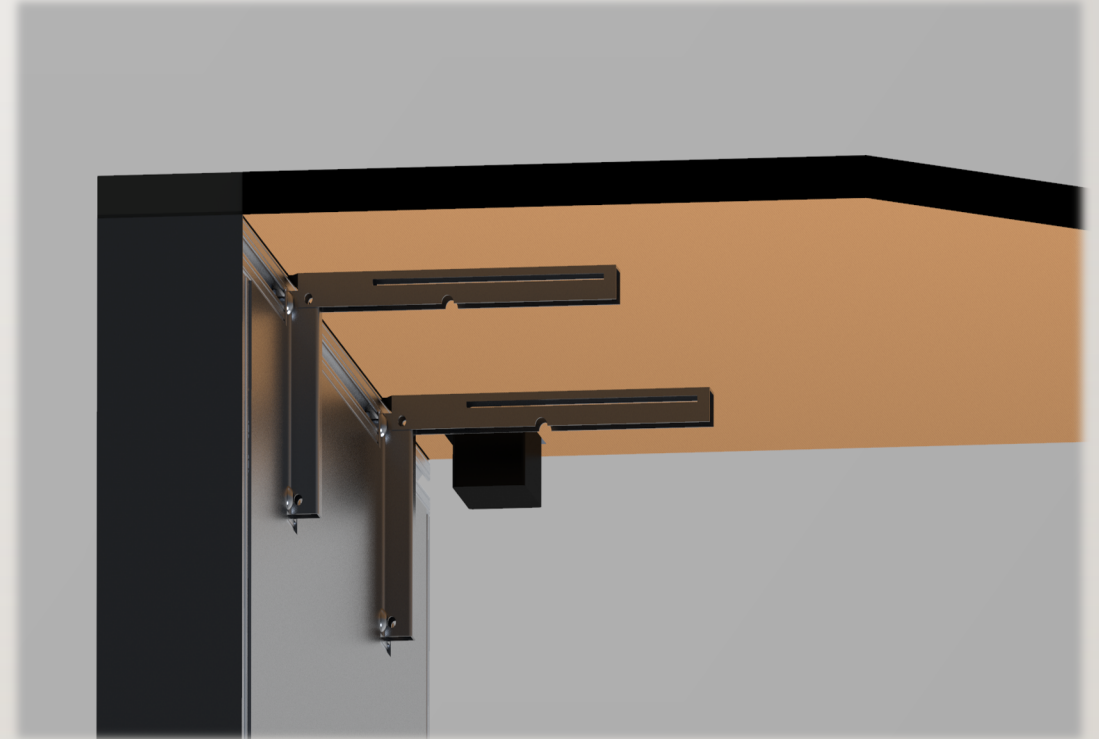
<b>Budget (\$)</b>	<b>2000.00</b>
Spent	1377.39
Remaining	622.61

Lauren Smith



# Shelf Bracket

- The bracket will be connected to the tabletop
- It is connected to 80/20 through T-nuts and bolts



Anthony Muniz



# Shelf Bracket

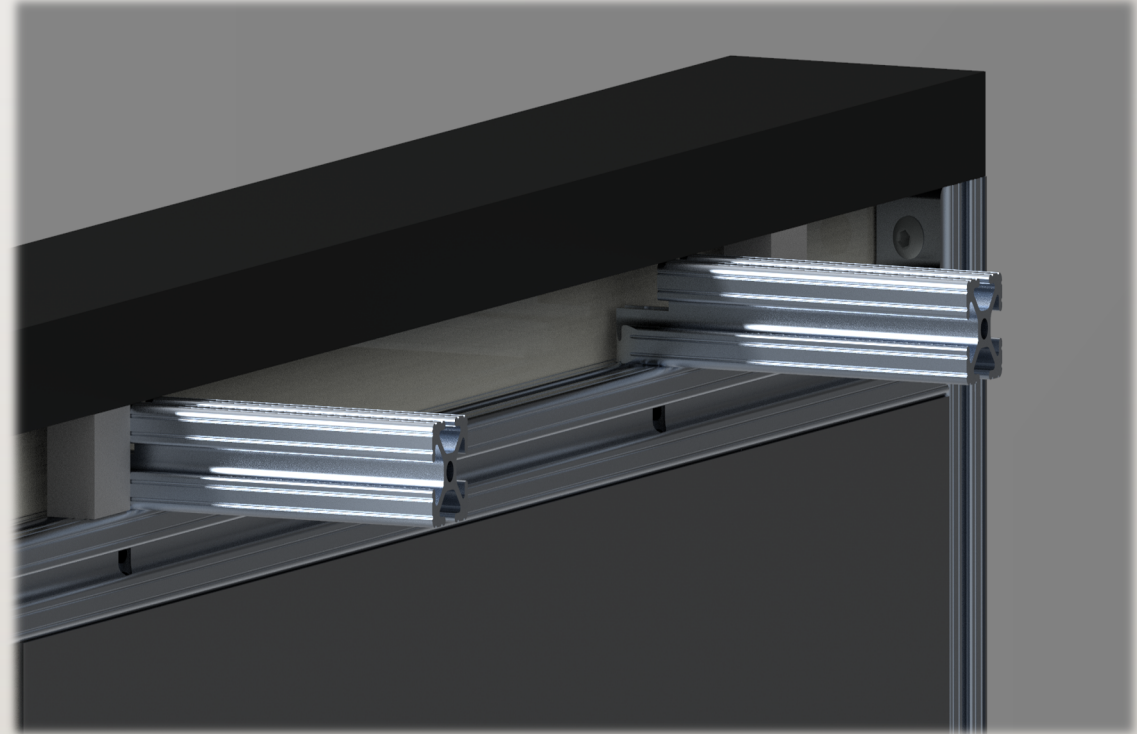
- In order to set-up tabletop you lift until it snaps into place
- To lower you lift tabletop slightly higher than 90 degrees and push locking mechanism



Anthony Muniz

# Swivel Arm

- Swivel arms are used to support the table once lifted
- Made of left over 80/20
- Swivel arms are attached through a bolt that allows it to rotate
- Stopper on the outside to make sure users don't move them inward



Anthony Muniz

# Whiteboard

- Frame is lifted by gas strut
- Gas strut allows for a slow movement upward and for it to automatically raise when not locked
- To lower it will take a couple pounds of downward force and lock mechanism



Anthony Muniz



# Whiteboard

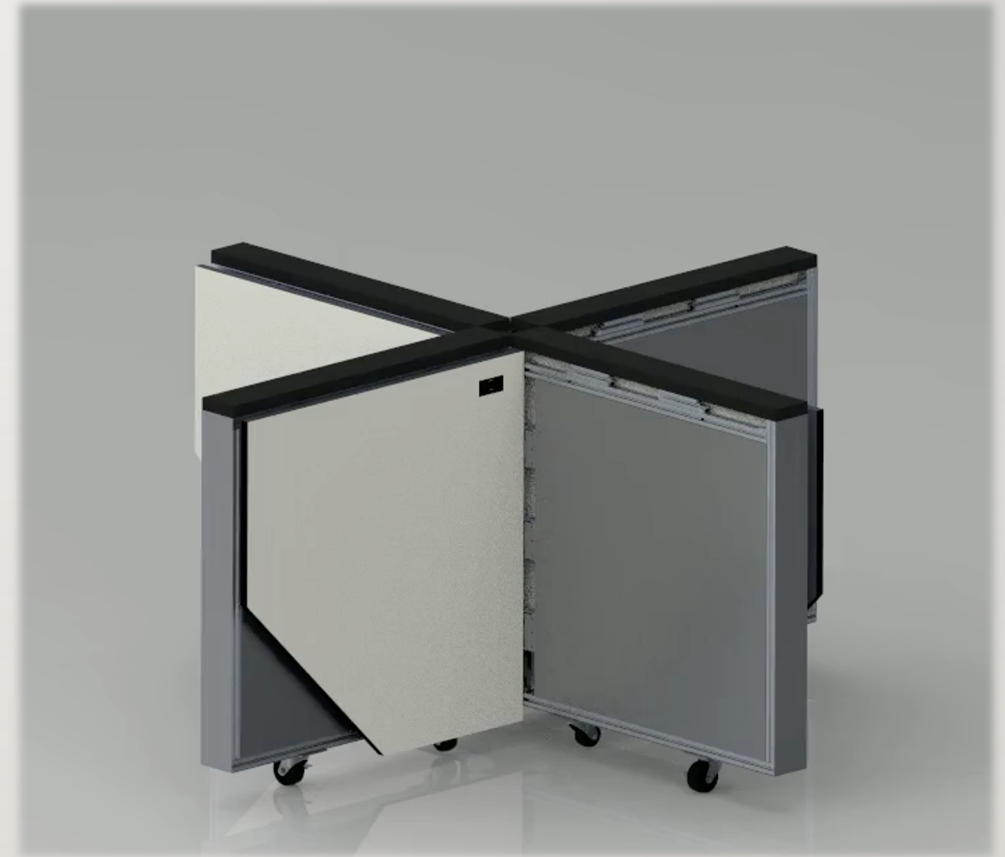
- Whiteboard is supported by frame made of wood
- Whiteboard is held in place by slider attached to space in 80/20
- Raise 21 in. above tabletop to provide user isolated spaces



Anthony Muniz

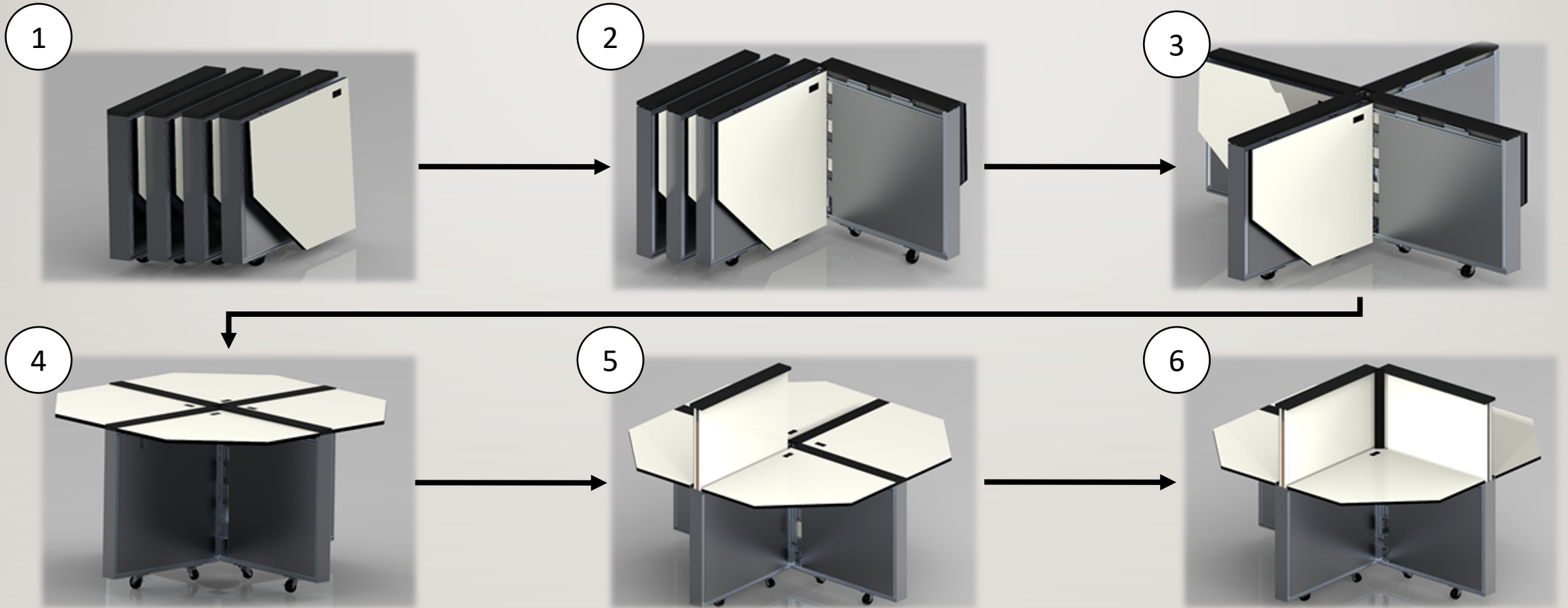
# Table

- Each whiteboard is able to be raised by itself
- Swivel wheel allows for table to be open and turned easily
- Magnetic accordion cardboard material allows for the gap to be closed and user to be totally isolated



Anthony Muniz

# Design



Anthony Muniz



# Modular

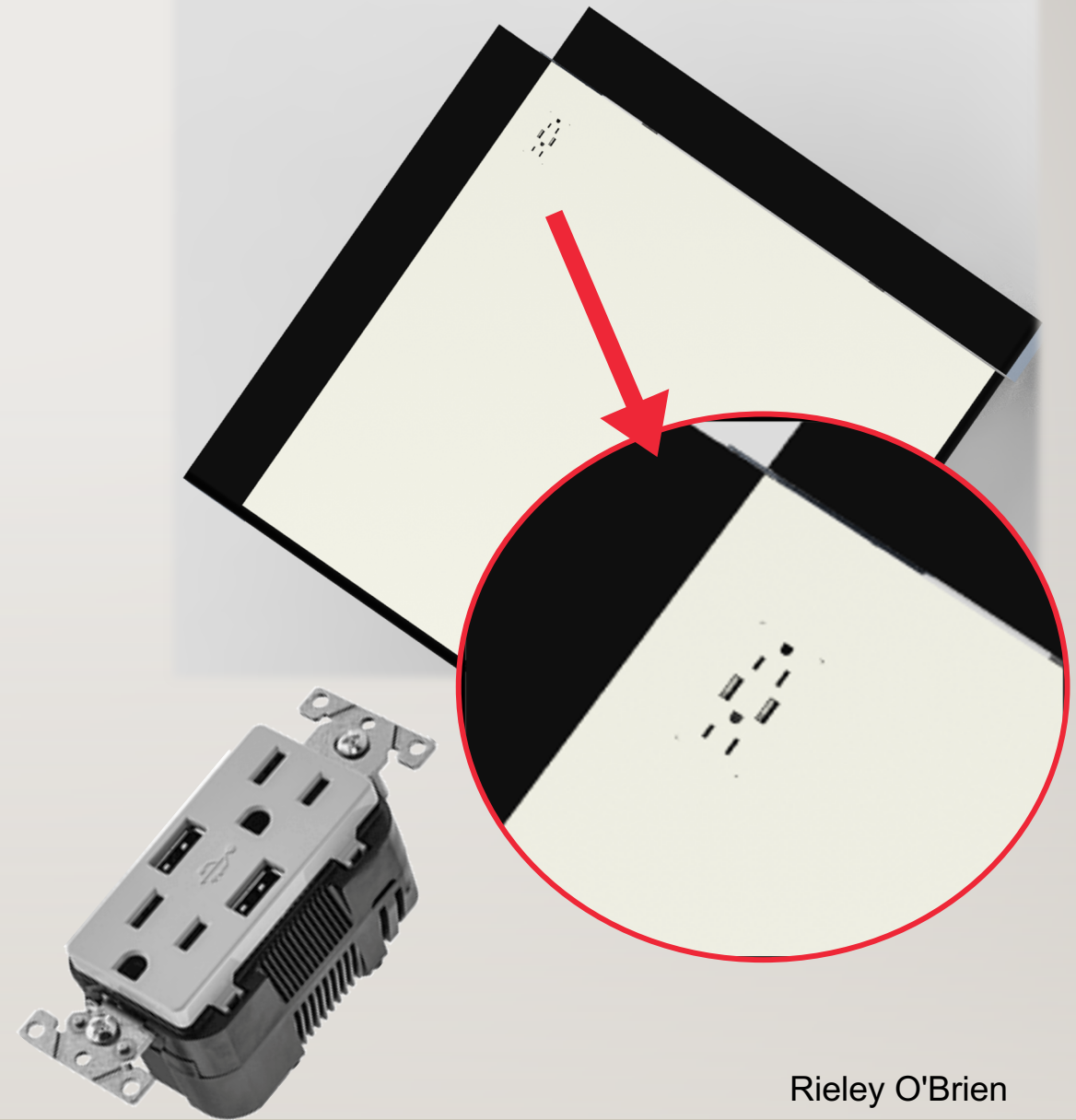
- The table is modular meaning easy to replace whole sections and change holistic design
- Pieces are connected using nuts and bolts so parts can be replaced or swapped in or out.



Anthony Muniz

# Power Integration

- The power receptacles we choose were 120V dual standard outlet dual USB outlet
- One outlet per seat totaling at 4 outlets per table
- Outlet will sit flush, and cords will travel via conduit out the bottom of the tabletop and through the slotted section of the 80/20
- All wiring will meet in the middle to then be joined into a singular plug capable of use at any standard outlet



Rieley O'Brien

# Scaled Prototype

- To focus on some of the main features of this table, we built a 1/6th scaled model
- Features such as the modular design, the use of pocketed dividers and the reduction of volume
- It was here we noticed that the hinging would need more designing



Rieley O'Brien



# Full-size Model

- Our next step in modeling was a full-size section of the table constructed out of plywood
- Due to the modular design we decided only one section (2 legs, 1 tabletop)
- Used to confirm:
  - A locking mechanism to hold up the tabletops
  - Height was acceptable
  - Lighter/stronger material was needed



Rieley O'Brien



# Full-size Model

- Model aided in determining function of:
  - Mechanism for raising the whiteboards
  - Hinges with a 90 degrees stop for legs
  - Correct size and placement of 360 degrees rotating caster wheels
  - Support placement for tabletop when opened



Rieley O'Brien

# Work on Official Prototype

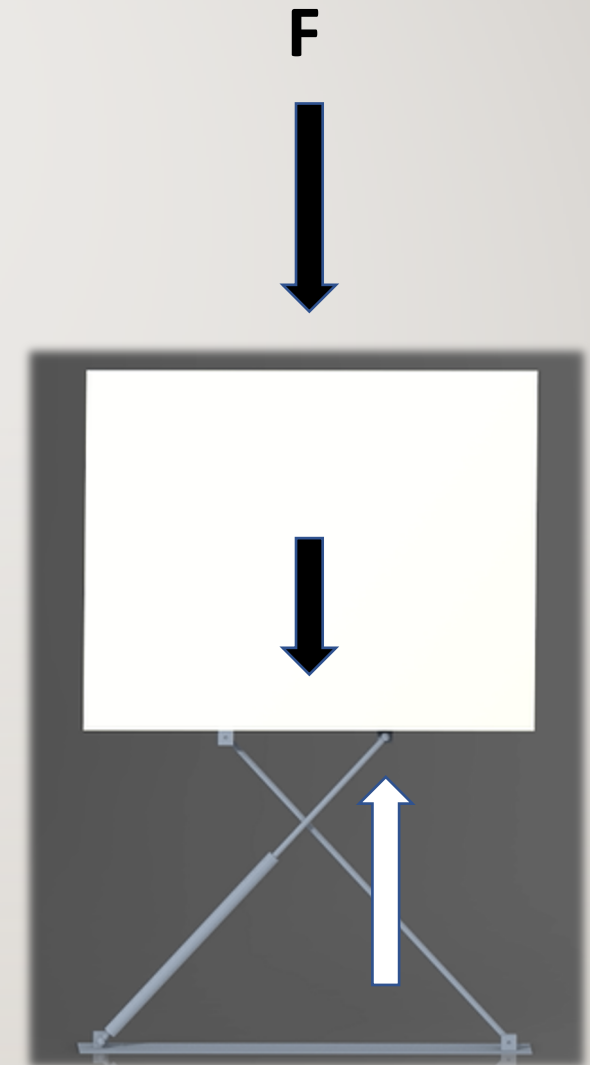
- Construction of the legs and tabletops had been completed to specifications and were working well
- Unfortunately due to circumstances a full-size model was never fully constructed as we could no longer get parts machined
- Because of this we designed the prototype 100% virtually
- The parts we had were going together as planned



Rieley O'Brien

# Forces for Dividers

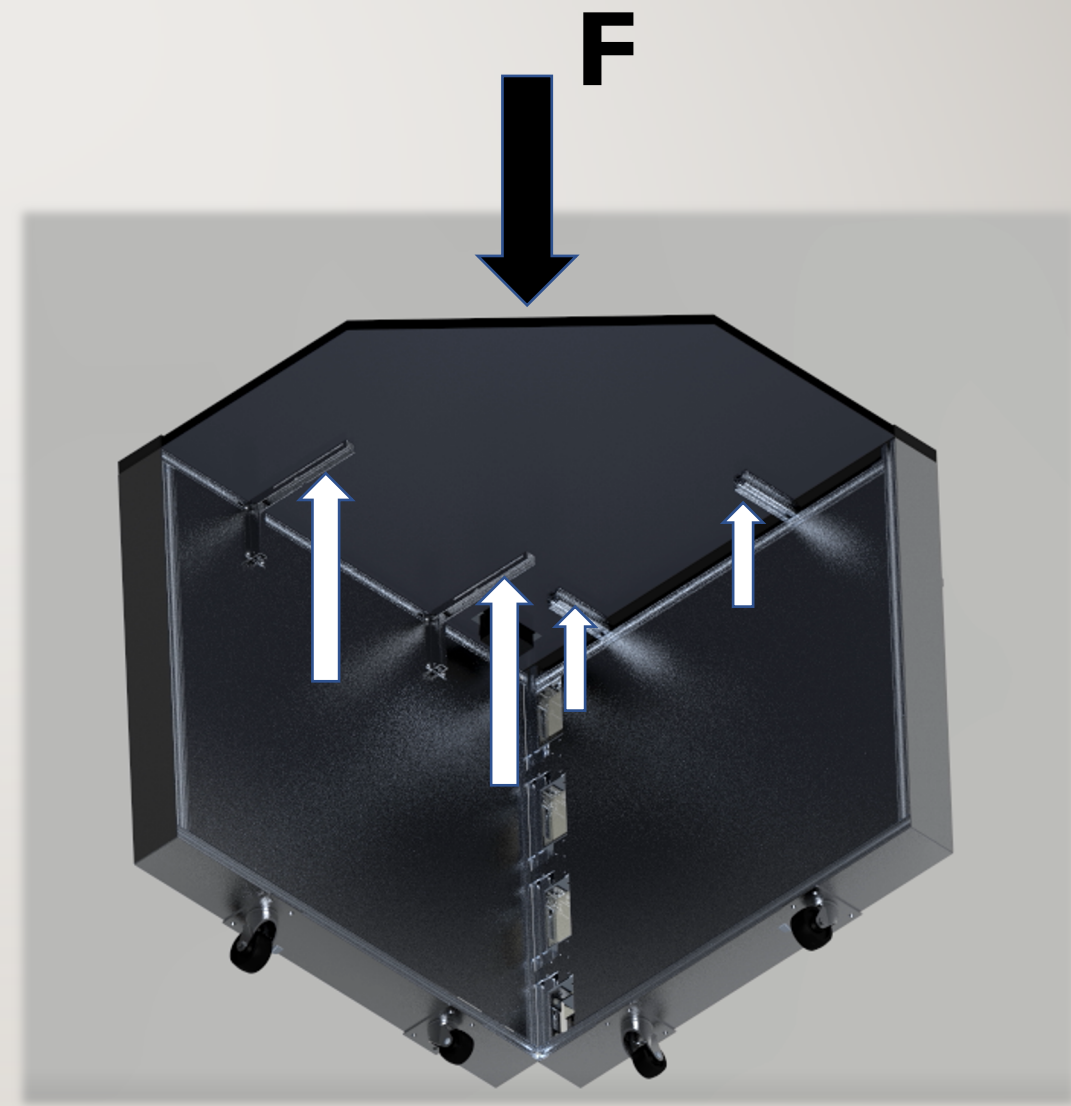
- We picked a gas strut rated at 7.5 lbs. lifting force
- Weight of the dividers are about 2.5 lbs.
- Needs a max force of 6 lbs. pushing down to lower this mechanism



Rieley O'Brien

# Tabletop Strength

- The shelf bracket was determined to be the point at which the table would fail
- Each hinge was rated at 370 lbs. And so we determined that each tabletop would be able to support 580 lbs.



Anthony Muniz



# Lessons Learned

- A more *extensively detailed* plan developed early on will lead to better overall flow of the project
- Prototyping – despite the goal being a functional prototype, to arrive at this more successfully it would be wise to:
  - Start earlier
  - Complete many, many more prototype iterations
- Determine the demanding aspects we want to focus heavily on

Alec Ellis

# Design Improvements

- The 80/20 framing substituted for a hollow aluminum frame would decrease unnecessary weight and reduce cost (nuts & bolts → welding)
- Push release mechanism added to the swivel arms for simpler deployment, not requiring reaching under the tabletop
- Certain less important user features were not implemented because of time
  - Bag hooks
  - Handles
  - Wireless charging pads
- Less mechanically complicated design overall

Alec Ellis

# References

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*"We are what we repeatedly do. Excellence, then, is not an act, but a habit."*

*~Aristotle*

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