

Team 506 MeWee Table

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Team Introductions



Alec Ellis

Project Manager/
Human Factors
Engineer



Kyle Innis

Geometric
Integration
Engineer



Lauren Smith

Materials Science
Engineer



Rieley O'Brien

Systems Engineer



Anthony Muniz

Mechanical Systems
Engineer

Visionary, Sponsor, and Advisor



Mr. Bill Lindner
Campus Reimagined (CRI)



Mr. Peter Butler
Campus Reimagined (CRI)



Dr. Patrick Hollis
FAMU-FSU College of
Engineering

Alec Ellis



Objective

- To design and build a multipurpose table allowing for collaborative/group work and individual work

Alec Ellis



Everyone's Problem

- We have all been to a location that did not have enough seats or had inefficient use of the available space
 - For us students it is the libraries, where thousands of students go to get assignments done, and usually there isn't enough space
 - For others this is going to a coffee shop and there not being anywhere to sit

Alec Ellis

Project Background

- Tables are the primary object that people use to do work on and collaborate with others
- University libraries have limited table space with some tables only having one to two people sitting at them
- A specific table design is needed to reduce unutilized space and increase work efficiently



Alec Ellis

Previous Work

- Customer needs obtained
- Project scope established
- Functional decomposition
- Research
- Sponsor collaboration
- Adviser collaboration
-
-

Alec Ellis

Libraries Are for Studying

- Gensler research found that libraries rank highest for both individual and group study, above these others:
 - Dorm/apartment, lounge, café, outdoors, lab space, classroom
- Avg. **13.5** hours/week **alone** vs. **4.3** hours/week **collaborative/group**
- Highest performing students count on libraries for a peaceful, isolated study environment



Alec Ellis



What do the students want?

Because students are the proposed users, we want to know that our ideas are consistent with what they want

Qualtrics survey has been created and awaiting distribution approval

We are hoping to solidify design ideas and possibly be introduced to new ones

Alec Ellis



Targets and Metrics

Function	Target	Metric	Tools
Writing/Drawing Space	A whiteboard that is 24x30 cm in size	Size (cm)	Tape measurer
Separates Workspace	Each section of the table will be 0.5m ²	Size (m ²)	Tape measurer
Stores Items	The storage space is 280 cm ²	Size (cm ²)	Tape measurer
Dampens Sound	dampen sound to within 20-40 dBA	Sound energy	Microphone
Supplies Power	Provides 120 Volts at 60 Hz	Electric potential (V and Hz)	Multimeter
Innovative	The table is inviting to the public	Opinion (survey)	Survey what people think of the table
Compactable	Reduce size to 75% of the original size	Size (m ³)	Tape measurer
	Weighs no more than 40kg	Size (kg)	Scale
	Covers between 1.5m ² -3m ²	Size (m ²)	Tape measure
	Supports 350 kg	Weight (kg)	Scale

Anthony Muniz

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Anthony Muniz

Concept Generation

Morphological Chart

Reducing unused workspace	Provides individual workspace	Provides group workspace	Supports work tools	Reduces distractions
Portable with wheels ●	Multiple dividers that create 4 sections	Dividers can be taken off ●	Power supply to charge items	Sound dampening
Adjustable with moving components	People at the table have to push a button to detach a divider ●	Parts of the table extend for someone to use	Whiteboard	Storage space to place phones ●
Expandable with additional components	A section of the table can be removable	Table can change shape to account for different people	Measuring tools ●	Desk dividers that surround people

Anthony Muniz

Concept Generation

Biomimicry

- Used features seen in a nature to generate concepts:
 - Wahne's parotia was used to generate a concept for dividing the table using a fan like structure
 - An armadillo shell was thought of to separate the table users



Anthony Muniz

Concept Generation

Medium Fidelity Ideas

- 1 outlet and 2 USB per person
- Double layer table
- Small pillar in the middle
- Paper hand fan table dividers
- Pulley rope system

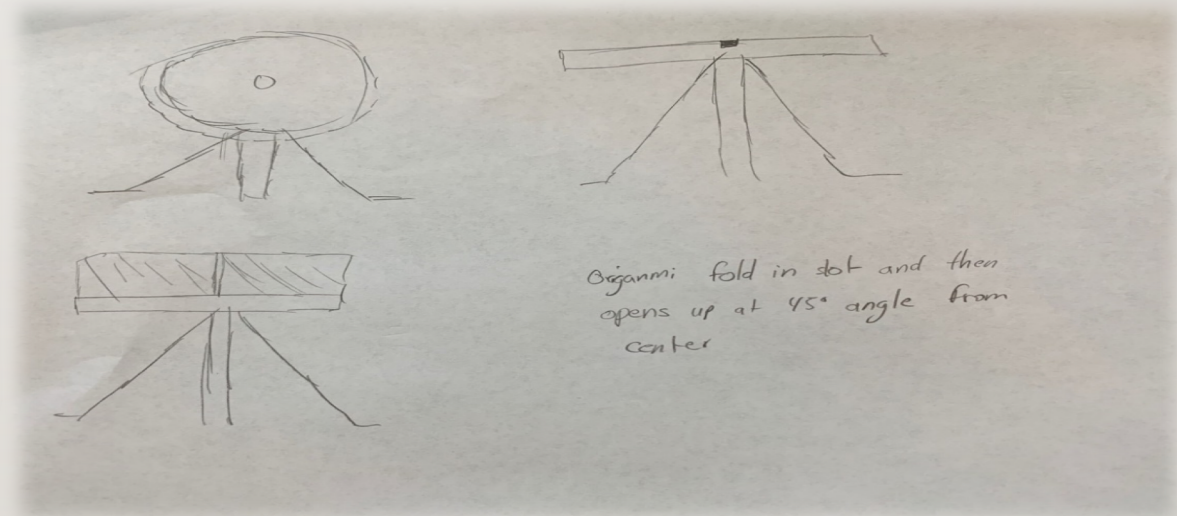
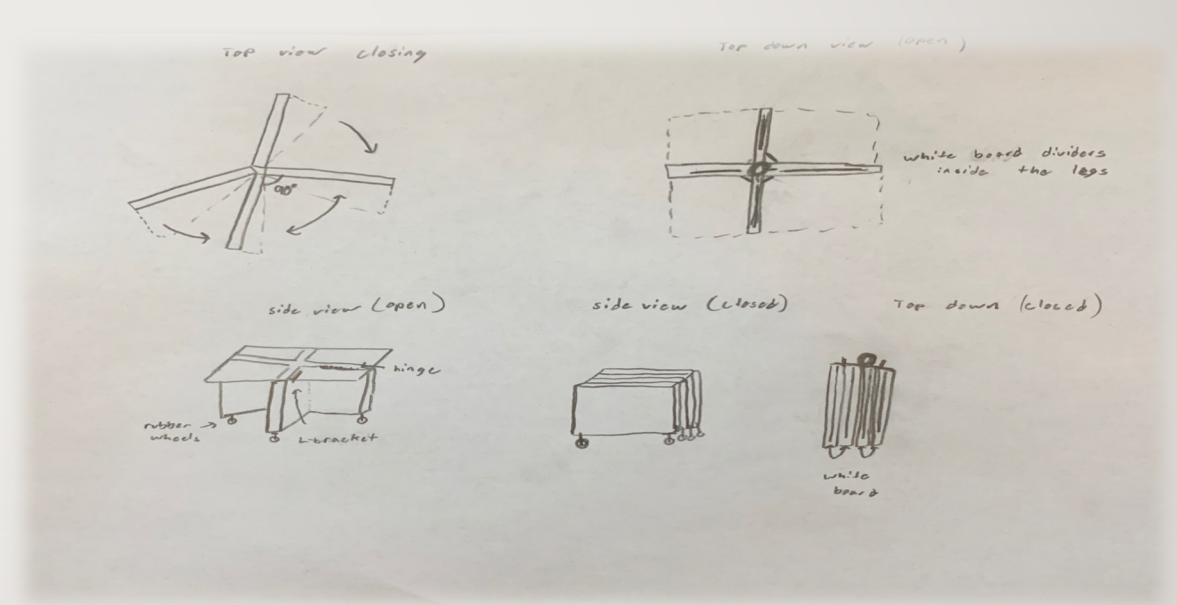


Anthony Muniz

Concept Generation

High Fidelity Ideas

- Origami design
- Aluminum support structures
- Folding design



Anthony Muniz

Concept Selection

Binary Pairwise Table

- Binary pairwise table compares the customer needs to each other
- Establishes which needs are the most important
- Used in weighing the customer needs for the House of Quality
- Most important needs are functionality, user simplicity, and compactability

Customer Needs	1.	2.	3.	4.	5.	6.	7.	Total 1
1. Functionality	-	1	1	1	1	1	1	6
2. User Simplicity	0	-	1	1	1	1	1	5
3. Safety	0	0	-	0	1	1	0	2
4. Compactability	0	0	1	-	1	1	1	4
5. Aesthetics	0	0	0	0	-	0	0	0
6. Cost	0	0	0	0	1	-	1	2
7. Weight	0	0	1	0	1	0	-	2
Total 2	0	1	4	2	6	4	4	n-1 = 6

Kyle Innis

Concept Selection

House of Quality

Relative Weight	Customer Importance	Customer Requirements	Functional Requirements										
			Direction of Improvement	□	▼	□	□	▼	▲	▲	▼	□	▲
			Writing/drawing space integration	Time to setup table	Power integration	Workspace size	Time to divide workspace	Ease of transportation	Sound dampening	Injury risks	Ability to store items	Consensus of table design	Price of construction
26%	5	Functionality	●	▼	●	●	○	▼	○	▼	●	▼	▼
21%	4	User's Simplicity	▼	●	▼	▼	●	○	▼	●	▼	○	▼
5%	1	Safety	▼	▼	▼	▼	▼	▼	▼	●	▼	▼	▼
16%	3	Compactability	▼	●	▼	○	○	●	▼	▼	▼	▼	▼
11%	2	Aesthetics	▼	▼	▼	▼	▼	▼	▼	▼	▼	●	▼
11%	2	Cost	○	▼	●	○	▼	▼	○	▼	○	▼	●
11%	2	Weight	○	▼	○	●	▼	▼	○	▼	○	▼	○
Importance Rating Sum (Importance			352.63	395	416	447	353	268	195	311	353	226	205.3
Relative Weight			11%	12%	13%	13%	11%	8%	6%	9%	11%	7%	6%

- House of quality illustrates what functional requirements satisfy what customer needs
- Top functional requirements satisfy our top customer needs

Kyle Innis

Concept Selection

Pugh Chart

Alternatives	Baseline	Folding Table	Panel Table	Branch Table	Pop-Up Table	Origami Table
Writing/drawing space integration	▲ 0	▲ 1	▲ 1	○ 0	▲ 1	○ 0
Time to setup table	○ 0	▼ -1	▼ -1	▼ -1	▼ -1	▼ -1
Power integration	○ 0	▲ 1	▲ 1	▲ 1	▲ 1	▲ 1
Workspace size	○ 0	▲ 1	▲ 1	○ 0	▲ 1	▲ 1
Time to divide workspace	○ 0	▼ -1	▼ -1	▼ -1	▼ -1	▼ -1
Ease of transportation	○ 0	▲ 1	▼ -1	▲ 1	▲ 1	▲ 1
Sound dampening	○ 0	▲ 1	○ 0	○ 0	○ 0	▲ 1
Injury risks	○ 0	▲ 1	▲ 1	▲ 1	▲ 1	▲ 1
Ability to store items	○ 0	▲ 1	○ 0	○ 0	▲ 1	▲ 1
Consensus of table design	○ 0	▲ 1	▲ 1	▲ 1	▲ 1	▲ 1
Price of construction	○ 0	▲ 1	▲ 1	▲ 1	▲ 1	▲ 1
Values	Positive	▲ 9	▲ 6	▲ 5	▲ 8	▲ 8
▼ -1	Negative	▼ -2	▼ -3	▼ -2	▼ -2	▼ -2
○ 0	Rank	1	4	5	2	2
▲ 1						

Alternatives	Folding Table	Origami Table
Writing/drawing space integration	○ 0	▼ -1
Time to setup table	○ 0	▲ 1
Power integration	○ 0	○ 0
Workspace size	○ 0	○ 0
Time to divide workspace	○ 0	○ 0
Ease of transportation	○ 0	▼ -1
Sound dampening	○ 0	▼ -1
Injury risks	○ 0	▲ 1
Ability to store items	○ 0	○ 0
Consensus of table design	○ 0	○ 0
Price of construction	○ 0	▲ 1
Values	Positive	▲ 3
▼ -1	Negative	▼ -3
○ 0	Rank	1
▲ 1		

- Pugh chart identifies a promising concept in a list of alternatives
- First Pugh chart has our top concepts being origami, folding, and pop-up
- Last Pugh chart shows the origami concept and folding concept have the same pros and cons

Kyle Innis

Concept Selection

Analytical Hierarchy Process

Development of Candidate Set of Criteria Weights [W]							
Criteria Comparison Matrix [C]							
	Functionality	Aesthetics	User's Simplicity	Safety	Compactability	Cost	Weight
Functionality	1.000	7.000	3.000	3.000	5.000	5.000	5.000
Aesthetics	0.143	1.000	0.333	0.200	1.000	1.000	0.333
User Simplicity	0.333	3.000	1.000	3.000	1.000	5.000	5.000
Safety	0.333	5.000	0.333	1.000	0.333	1.000	1.000
Compactability	0.200	1.000	1.000	3.000	1.000	1.000	1.000
Cost	0.200	1.000	0.200	1.000	1.000	1.000	1.000
Weight	0.200	3.000	0.200	1.000	1.000	1.000	1.000
SUM	2.410	21.000	6.066	12.200	10.333	15.000	14.333

Consistency Check		
Weighted Sum Vector	Criteria Weights	Consistency Factor
2.972	0.379	7.837
0.402	0.052	7.715
1.648	0.210	7.842
0.742	0.097	7.614
0.891	0.111	8.056
0.528	0.068	7.727
0.633	0.082	7.717
Average Consistency Vector		7.787
Consistency Index		0.131
Consistency Ratio		0.097

- AHP of customer needs establishes the best ones
- Each chart has a consistency check

Kyle Innis

Concept Selection

Analytical Hierarchy Process

Folding Table				
	Functionality	User Simplicity	Compactability	
Functionality	1.000	5.000	3.000	
User Simplicity	0.200	1.000	1.000	
Compactability	0.333	1.000	1.000	
SUM	1.533	7.000	5.000	
Normalized Folding Table [NormC]				
	Functionality	User Simplicity	Compactability	[Pi]
Functionality	0.652	0.714	0.600	0.656
User Simplicity	0.130	0.143	0.200	0.158
Compactability	0.217	0.143	0.200	0.187
SUM	1.000	1.000	1.000	1.000

Origami Table				
	Functionality	User Simplicity	Compactability	
Functionality	1.000	5.000	3.000	
User Simplicity	0.200	1.000	1.000	
Compactability	0.333	1.000	1.000	
SUM	1.533	7.000	5.000	
Normalized Origami Table[NormC]				
	Functionality	User Simplicity	Compactability	[Pi]
Functionality	0.652	0.714	0.600	0.656
User Simplicity	0.130	0.143	0.200	0.158
Compactability	0.217	0.143	0.200	0.187
SUM	1.000	1.000	1.000	1.000

- Each concept received its own AHP
- The AHPs determine how the concept relates to the customer needs
- Utilized our top three customer needs for the AHPs

Kyle Innis

Concept Selection

Final Design

Selection Criteria	Functionality	User Simplicity	Compactability	Criteria Weights
Folding Table	0.656	0.158	0.187	0.379
Branch Table	0.389	0.511	0.100	0.052
Pop-Up Table	0.480	0.406	0.115	0.210
Origami Table	0.656	0.158	0.187	0.097
Pannel Table	0.724	0.193	0.083	0.111

- Final rating matrix computed which concept is best suited for our customer needs
- Origami table and folding table received the same overall score

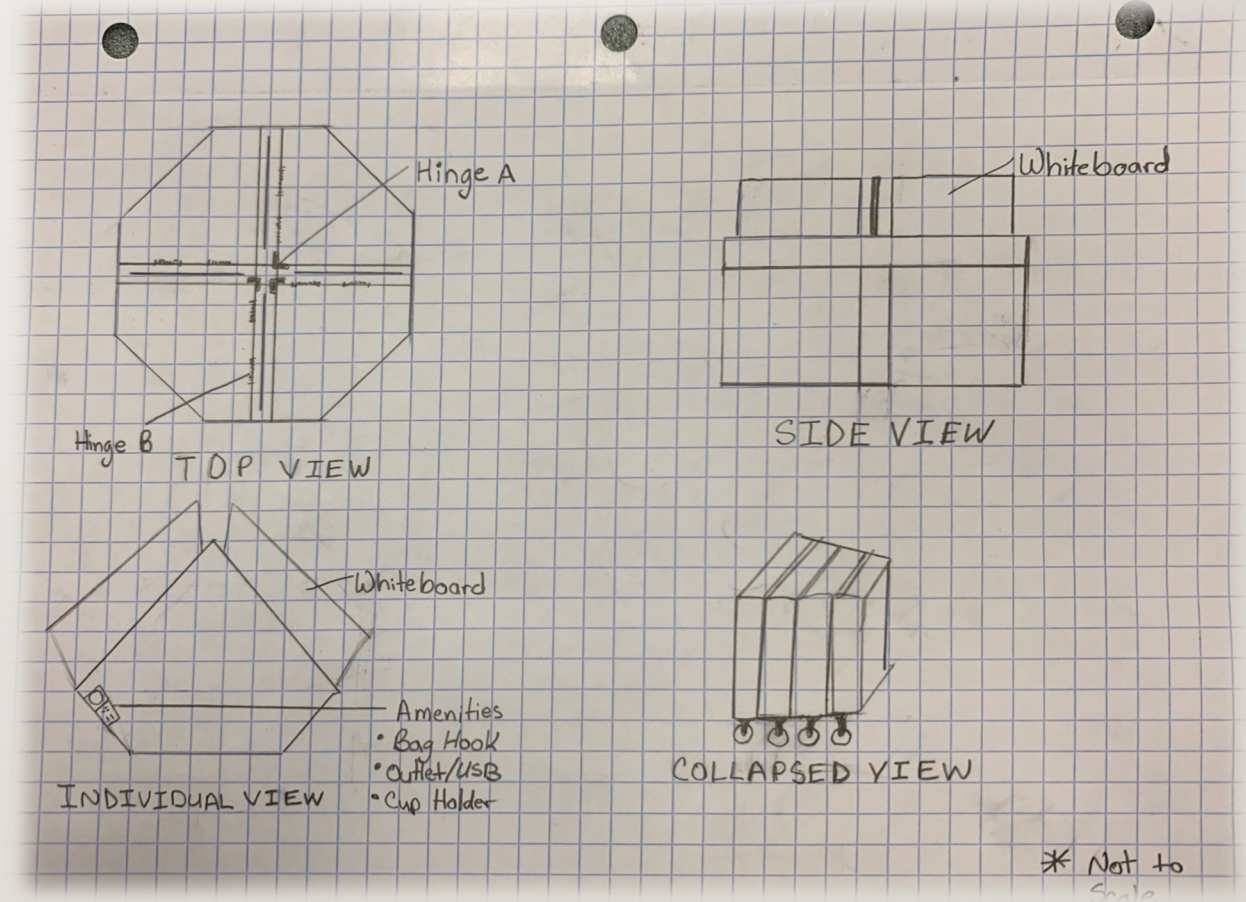
Concept	Alternative Value
Origami Table	0.296
Folding Table	0.296
Pop-Up Table	0.153

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Concept Selection

Final Design

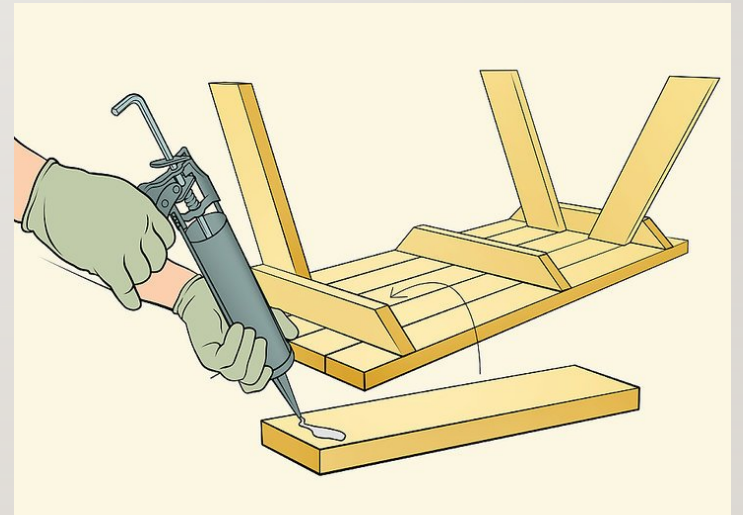
- Our final concept is the folding table design
- Sturdier and has a longer lifespan than the origami design
- Origami design wouldn't have whiteboards and wouldn't dampen sound as well



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Future Work

- CAD Model
- Prototype the folding table design
 - 3D print
- Order items from the bill of materials
- Construct and test the table



Kyle Innis

References

- 1) Barber, C. (Ed.). (2017). *Gensler Research Catalogue* (Vol. 2). Novato: ORO Editions
- 2) Free Image on Pixabay - Checklist, To Do, Activities, Boxes. (n.d.). Retrieved November 3, 2019, from <https://pixabay.com/illustrations/checklist-to-do-activities-boxes-1316848/>
- 3) <https://www.wikihow.com/Build-a-Picnic-Table>
- 4) Reynolds, S. (2013, October 24). What's the Future of 3D Printing? *Victoria and Albert Museum*

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

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

Department of Mechanical Engineering



FAMU-FSU
Engineering

Bill of Materials

Item	\$/Unit	Quantity	Price	Weight/Unit (lbs)	Total Weight (lbs)	Dimensions	Item Description	Line Completion %
Aluminum Square Tube	\$26.65	4	\$106.60	4.1	16.4	6' long 1-1/4"	Aluminum will be used for the base the table	45.00
Machine Screws	\$0.03	100	\$3.04	0.56	56	#8-32 7/8"	Screws will be used to attach the parts of the table	45.00
Whiteboard	\$54.45	4	\$217.80	14.1	56.4	47.2" x 35.4" x 1"	Whiteboards are used for additional drawing space	45.00
Rubber Wheels	\$7.19	5	\$35.95	0.16	0.8	2-7/8"	Wheels are used to move the table to other places	45.00
Piano Hinges	\$5.50	6	\$33.00	0.12	0.72	14" x 1.8" x 0.2"	Piano hinges to fold the tabletop and the legs of the table	45.00
Power outlet with USB-A	\$18.31	4	\$73.24	0.3	1.2	4" x 1.7" x 1.7"	Power outlet for users to plug in computers and other electronic device	45.00
Bolts	\$0.09	100	\$9.00	0.002	0.2	5" x 3" x 0.7"	Bolts are for the srews that will be used to attach the table	45.00
MakerBot PLA Filament, Ocean Blue	\$47.00	1	\$47.00	8.81	8.81	1.75 mm diam.	PLA will be used for the center column of the table and as a mesh barrier	45.00
Laminated Particle Board (1-1/8")	\$35.00	4	\$140.00	92	368	5'x 8' x 1-1/8"	Laminated particle board used for the table top of table	45.00
Butt Hinge	\$0.83	8	\$6.64	0.1	0.8	2" x 3"	Butt hinges to fold the tabletop and the legs of the table	45.00
Washers	\$0.04	100	\$4.00	0.0007	0.07	4" x 3" x 0.3"	Washers to support the screws for the table	45.00

➤ Total cost is \$676.27

Kyle Innis