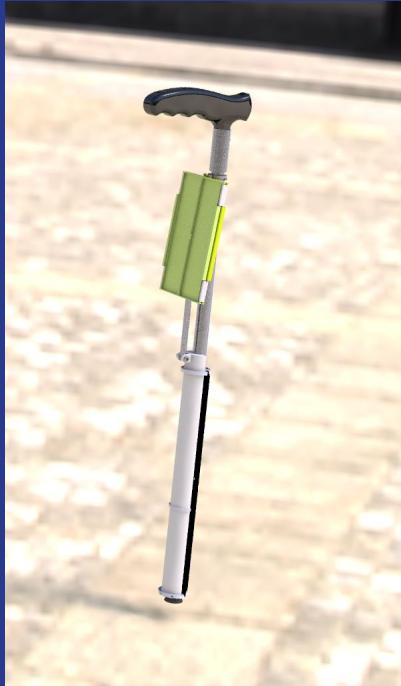


# SitStick

MEAM 5140: Final Presentation

Rohan  
Hrishi  
Thaer  
Claes



# Base Products:

Walking stick



Camping chair



# Voice of the customer

Those struggling to walk long distances without a break



# Customer Needs:

1-

- 1. SitStick has sufficient grip
- 2. SitStick is ergonomic to hold
- 3. SitStick is aesthetically pleasing

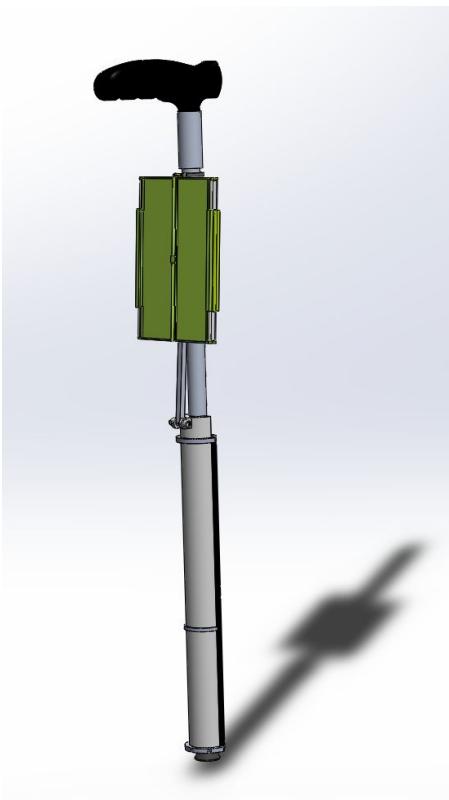
3-

- 1. Sitstick is easily accessible
- 2. SitStick is easy to store
- 3. SitStick is easy to deploy

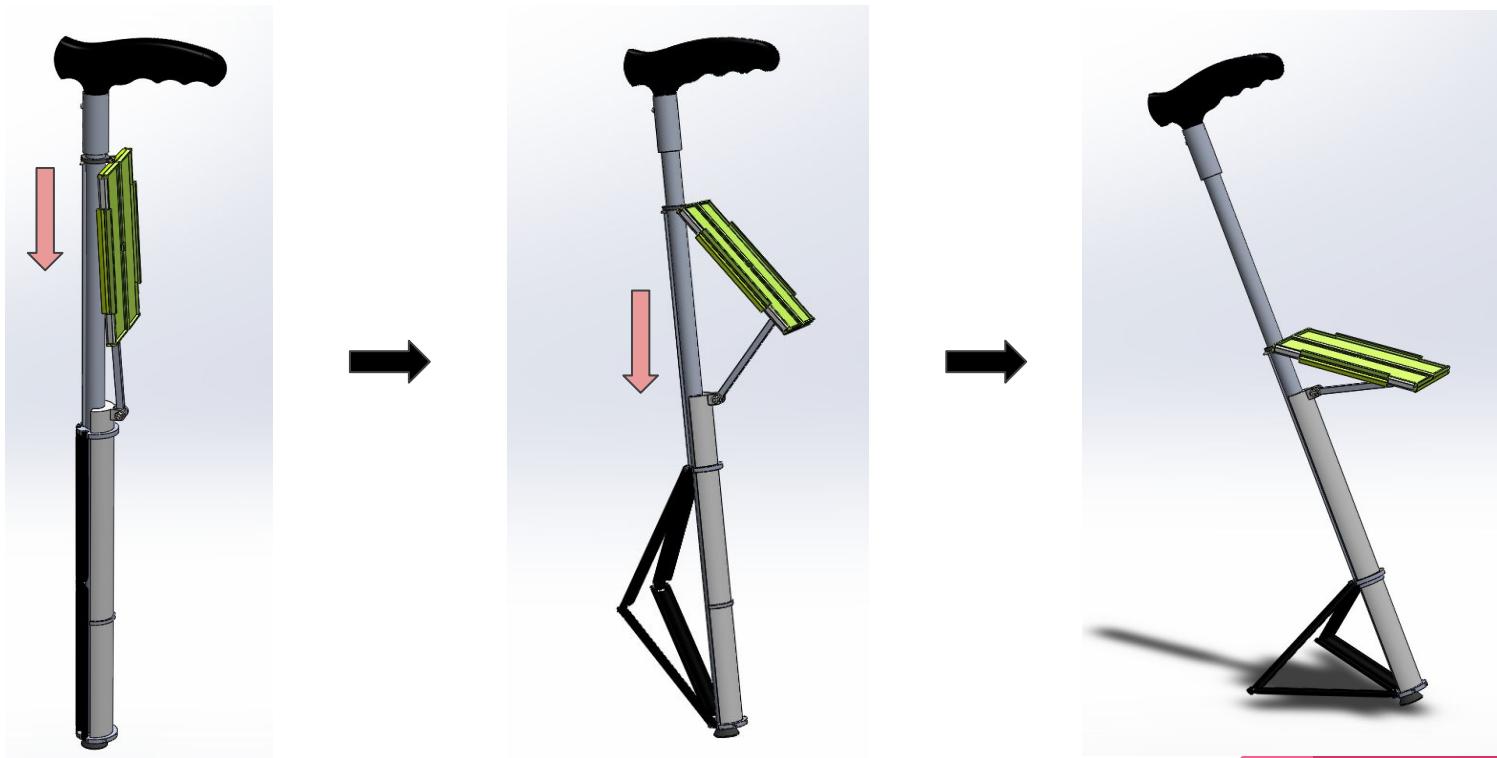
9-

- 1. Sitstick is lightweight
- 2. SitStick is durable
- 3. SitStick is adjustable

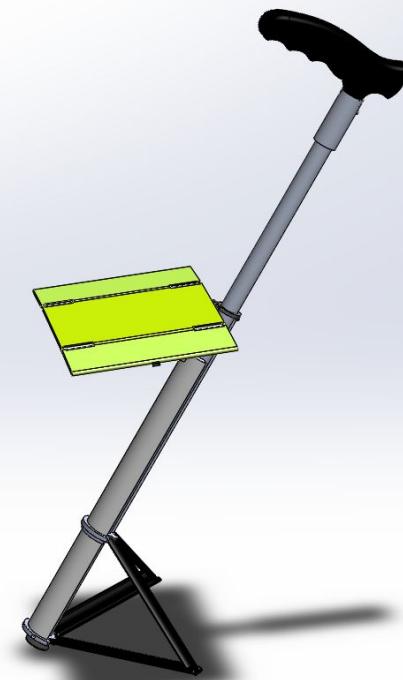
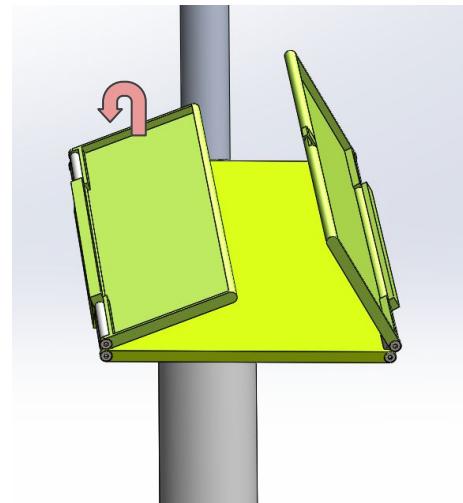
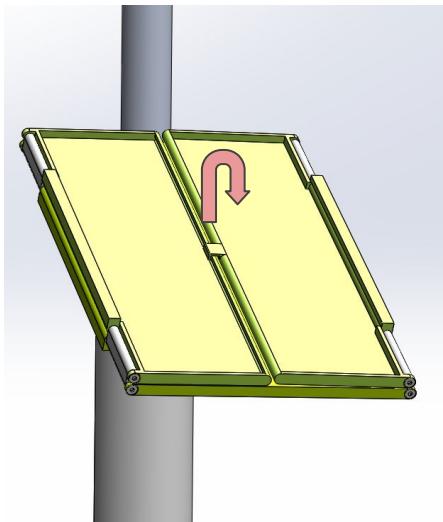
# 3D Model of product:



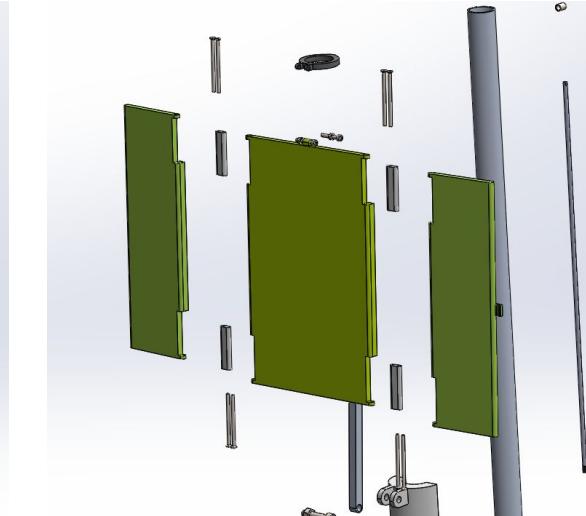
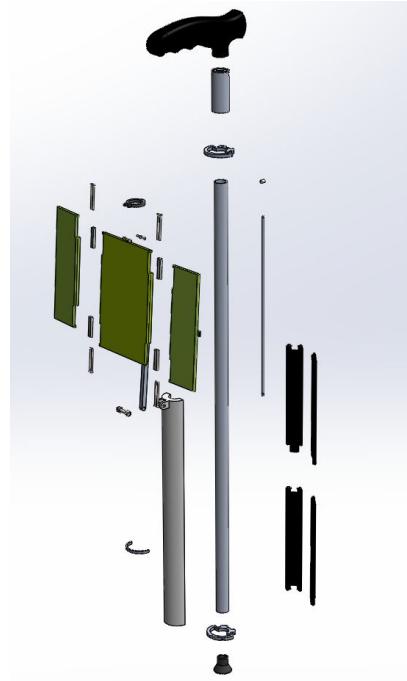
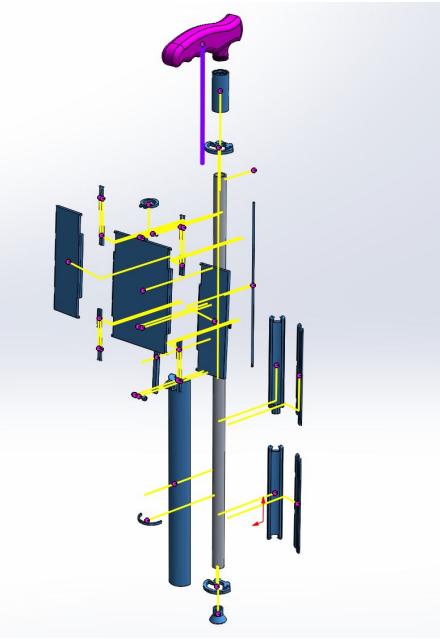
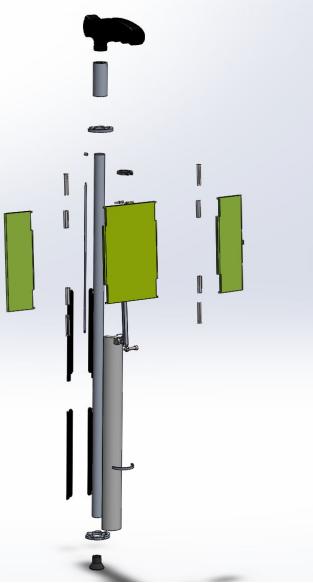
# Steps to use: Step 1



## Steps to use: Step 2



# Exploded View



# Handle S/A - Handle



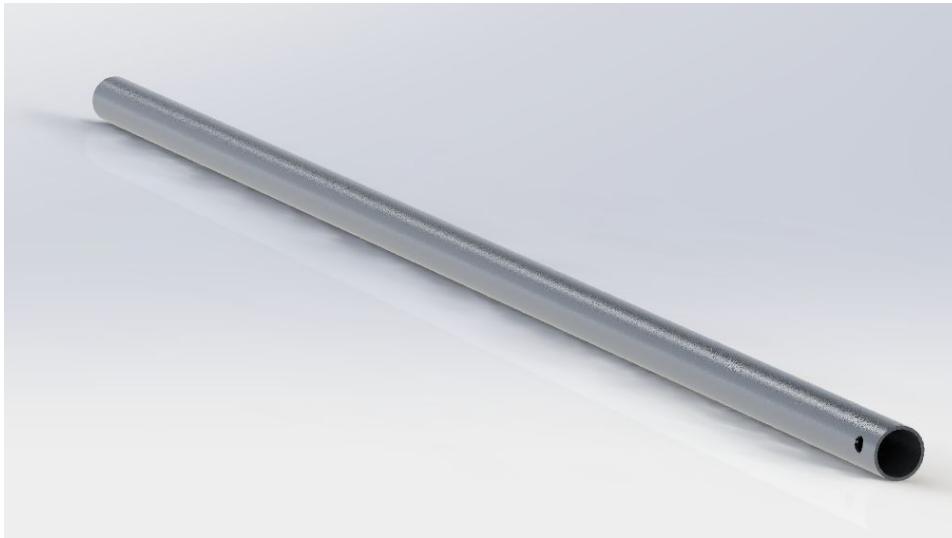
- Features:
  - Ergonomic design
  - Replaceable
- Materials:
  - PP
- Process:
  - Injection molding
- Assembly:
  - Attached to extender with the help of threads
- Cost Estimate:
  - Low: \$0.44
  - High: \$0.53

# Handle S/A - Extender



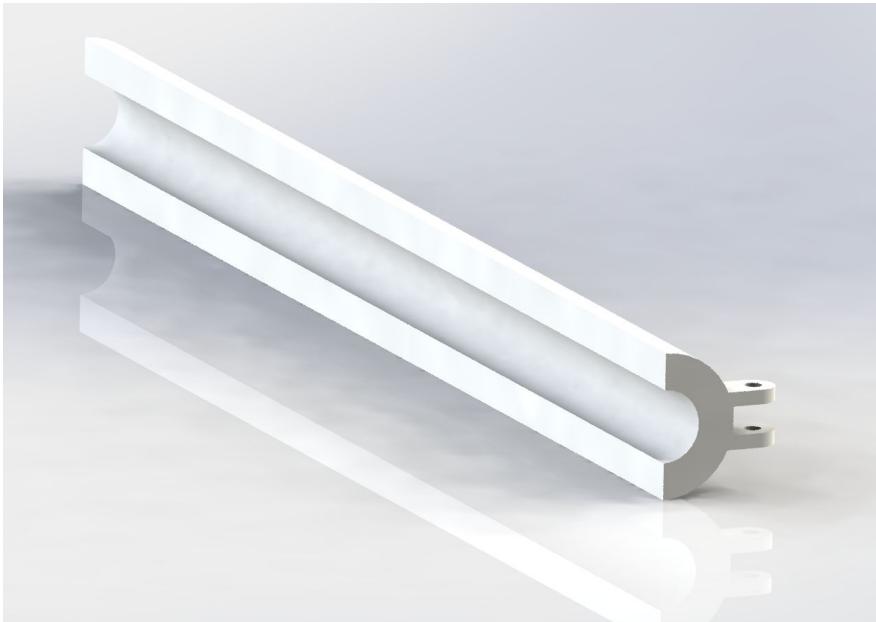
- Features:
  - Adjustment slots for height
  - Internal Threading for handle
- Materials:
  - Aluminum
- Process:
  - Aluminum Extrusion (Purchased pipe)
  - Internal Threading
  - Drilling
- Assembly:
  - Connected to centre rod with the help of snap button (valco pin)
- Cost Estimate:
  - Low: \$0.694
  - High: \$1.157

# Core S/A - Central Rod



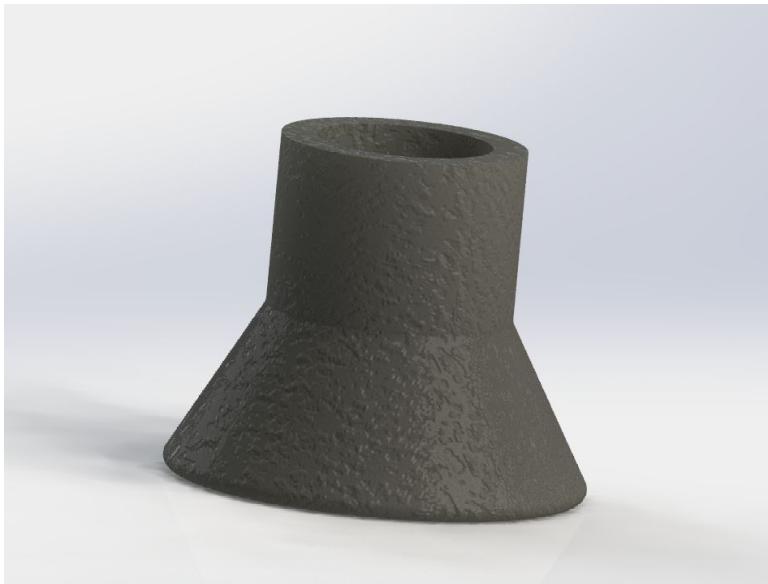
- Features:
  - 1in Diameter
  - 1/8in Thickness
- Materials:
  - Aluminum
- Process:
  - Aluminum extrusion (Purchased)
  - Drilling
- Supplemental Parts:
  - Snap button for length extension
- Cost Estimate:
  - Low: \$4.28
  - High: \$8.01

# Core S/A - Plastic Covering



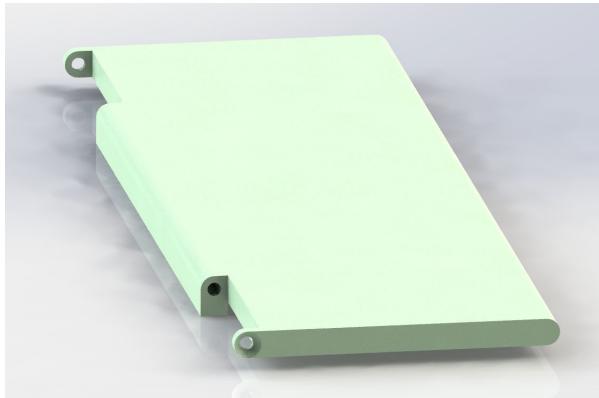
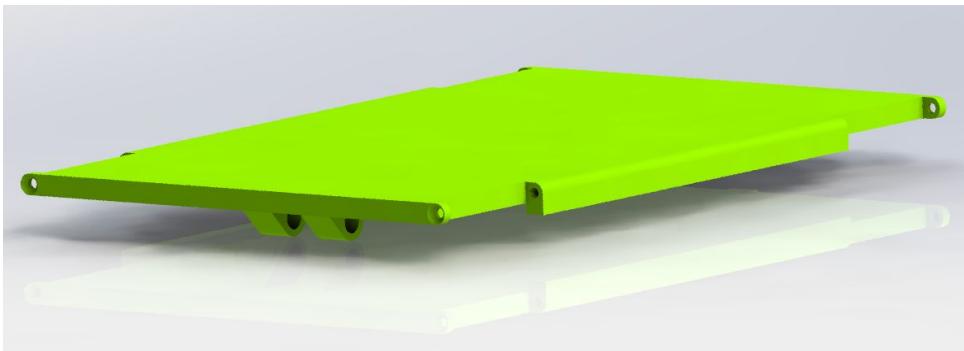
- Features:
  - Seamless Aesthetic
  - Adds weight for balance
- Materials:
  - PP
- Process:
  - Injection Molding
  - Adhesion
- Assembly:
  - Connected to centre rod with the help of epoxy adhesive
- Cost Estimate:
  - Low: \$1.73
  - High: \$2.07

# Core S/A - Rubber Base

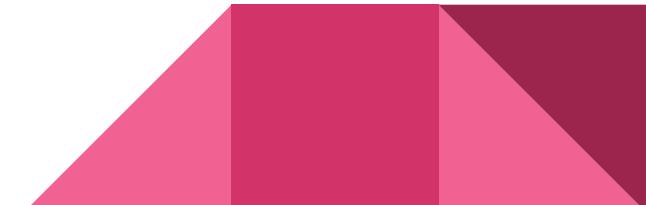


- Features:
  - Durable
  - Adds Grip
- Materials:
  - Rubber
- Process:
  - Rubber molding
- Assembly:
  - Connected to centre rod by press fit
- Cost Estimate:
  - Low: \$0.025
  - High: \$0.033

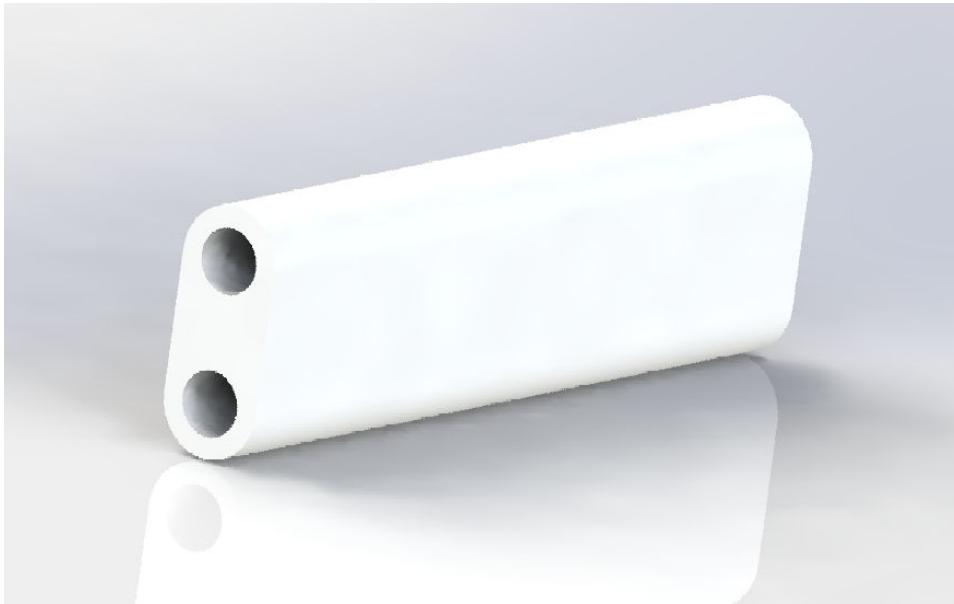
# Seat S/A - Seat



- Features:
  - Folds out into seat
  - Rounded edges for comfort
- Materials:
  - PP
- Process:
  - Injection molding
- Assembly:
  - Assembled with the help of hinge and taper head screws
  - Centre seat attached to sliding ring with M3 nut, bolt
- Cost Estimate:
  - Low: \$0.32
  - High: \$0.37



# Seat S/A - Hinges



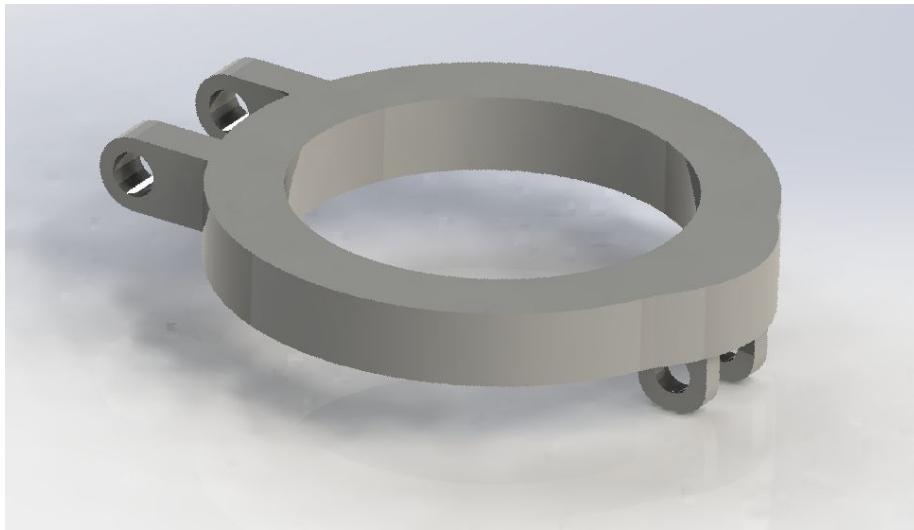
- Features:
  - Blends with seat
  - Rounded edges
- Materials:
  - PP
- Process:
  - Injection molding
- Supplemental Parts:
  - Screws
- Cost Estimate:
  - Low: \$1.44
  - High: \$2.41

# Seat S/A - Support



- Features:
  - Load bearing member
  - Rounded edges
- Materials:
  - Aluminum
- Process:
  - Waterjet Cutting
- Supplemental Parts:
  - Screws
  - Nuts
  - Sliding ring
- Cost Estimate:
  - Low: \$1.31
  - High: \$2.16

# Seat S/A - Sliding ring



- Features:
  - Slides onto centre stick. Transmits the sliding motion to the connecting rod.
- Materials:
  - PP
- Process:
  - Injection molding
- Assembly:
  - Connected to centre seat at one end and connecting rod at the other
- Cost Estimate:
  - Low: \$0.04
  - High: \$0.04

# Legs S/A - Slider

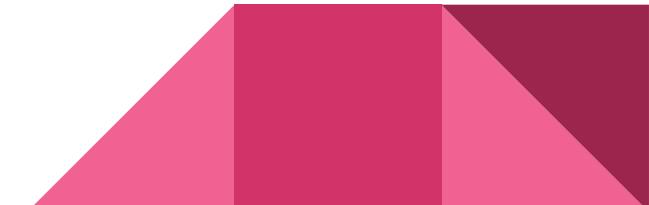


- Features:
  - Slides into the core. Acts as a pivot point for the legs.
- Materials:
  - Aluminum
- Process:
  - Waterjet cutting
  - Drilling
  - Tapping
- Assembly:
  - Is connected to the sliding ring with the connecting rod.
- Cost Estimate:
  - Low: \$0.33
  - High: \$0.43

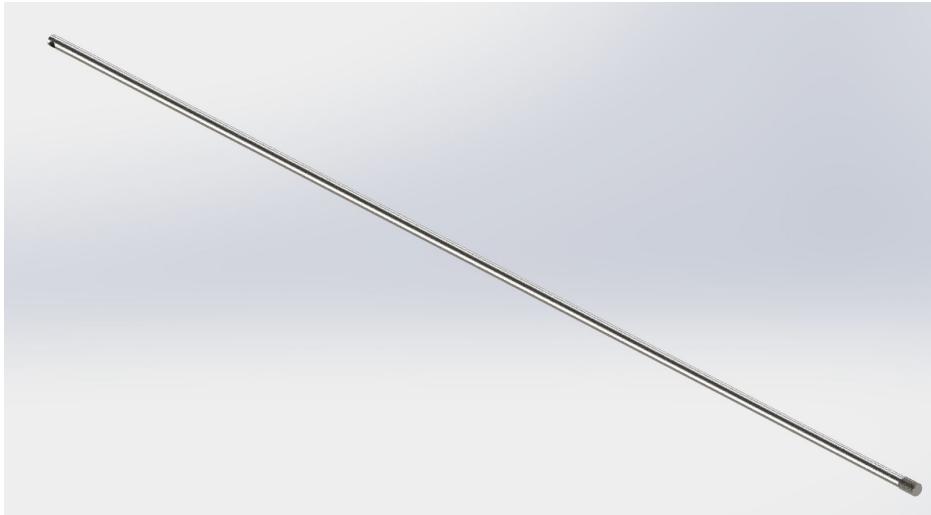
# Legs S/A - Legs



- Features:
  - Built in pins
  - Rounded edges
  - Male and Female components for ease of assembly
- Materials:
  - PP
- Process:
  - Injection molding
- Assembly:
  - Snap fit onto slider
- Cost Estimate:
  - Low: \$0.19
  - High: \$0.23



# Legs S/A - Connecting rod



- Features:
  - Transmits linear motion of the sliding ring to the slider.
- Materials:
  - Stainless Steel
- Process:
  - Drilling
  - External threading
- Cost Estimate:
  - Low: \$ 2.53
  - High: \$ 3.61

# Summary of Estimated Total Costs

<b>Group</b>	<b>Low Cost Estimate</b>	<b>High Cost Estimate</b>
Core S/A	6.33	10.25
Legs S/A	0.22	0.27
Handle S/A	1.13	1.68
Seat S/A	6.69	7.48
Labor and Overhead	6.09	8.67
<b>Total</b>	<b>20.47</b>	<b>28.36</b>

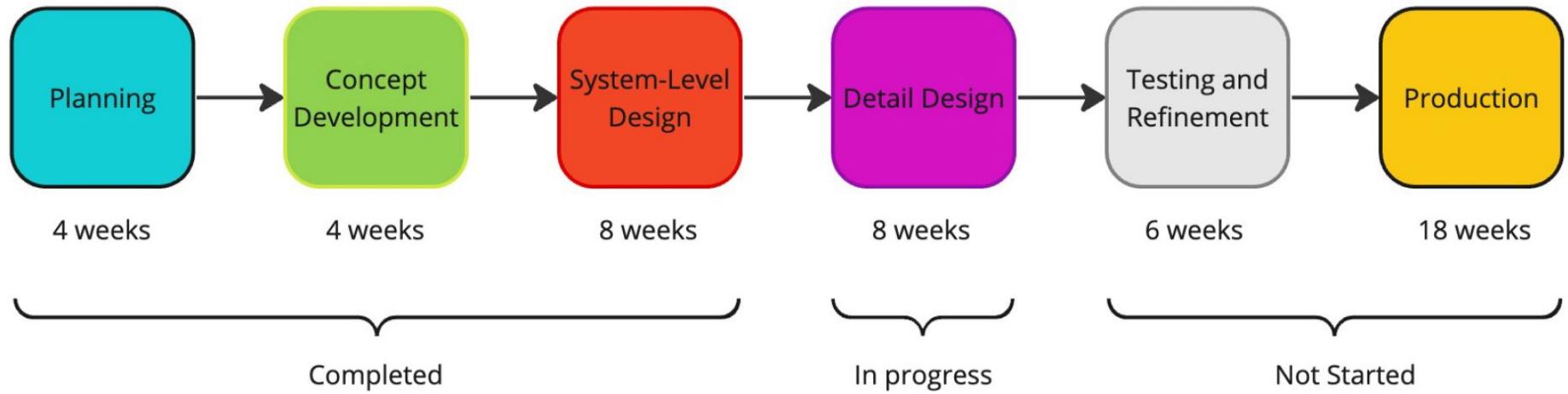
# Target Cost Analysis

Market Price		\$ 55
Retailer Margin	35%	\$19.25
Distributor Margin	18%	\$9.9
Manufacturer Margin	20%	\$13.75
Target cost		\$21.99

## Areas of concern

- If folding mechanism will take necessary weight
- Ease of use of folding mechanism for elder users
- Stability of walking stick (rubber)

# Production Timeline



# Thank You!

# Appendix

# Customer Needs

## MEAM514 Customer Needs Form

Customer name:	Munjid
Approximate age:	87
Gender:	Male
Other demographic info:	
Interviewer(s):	Thaer Alaggad
Date:	4/1/23
Currently uses:	Cane
Type of user:	Daily

Question/prompt	Customer statement	Interpreted Need
Show me a common way you use your walking stick/walker.	User grabs cane that is resting on the side of his chair.	Walking stick/ walker must be easily accessible.
	User carries cane and positions it in front of him with ease.	Walking stick/ walker is lightweight
	User gets up while supporting himself with the cane.	Walking stick/ walker must be robust and durable.
	User takes a few paces then stops while resting slightly on cane.	Walking stick/ walker must be able to bear weight.
	User returns to his seat and rests the cane on the side and sits down.	Walking stick/ walker is easy to store
How else do you use your walking stick/walker	User sometimes brings the cane as an accessory.	Walking stick/ walker must be aesthetically pleasing.
What do you like about your walking stick/walker	The hight of the cane is adjustable so it can be used by other people as well	Walking stick/ walker must be adjustable.
	The grip feels good in my hand	Walking stick/ walker must be comfortable and ergonomic to hold.
	The design of the cane looks good	Walking stick/ walker must be aesthetically pleasing.
What do you dislike about your walking stick/walker	Sometimes when walking the bottom slips on the ground.	Walking stick/ walker must have sufficient grip with the ground.
	I sometimes need more support than the cane offers so it is difficult to walk for long distances.	Walking stick/ walker must support the user.
Non-verbal observations	User took some time to properly rest the cane once done using it so it didn't fall over.	Walking stick/ walker must be easy to store.
	If the user was not actively walking they could not be stationary for long without finding somewhere to sit.	Walking stick/ walker must provide support when stationary.

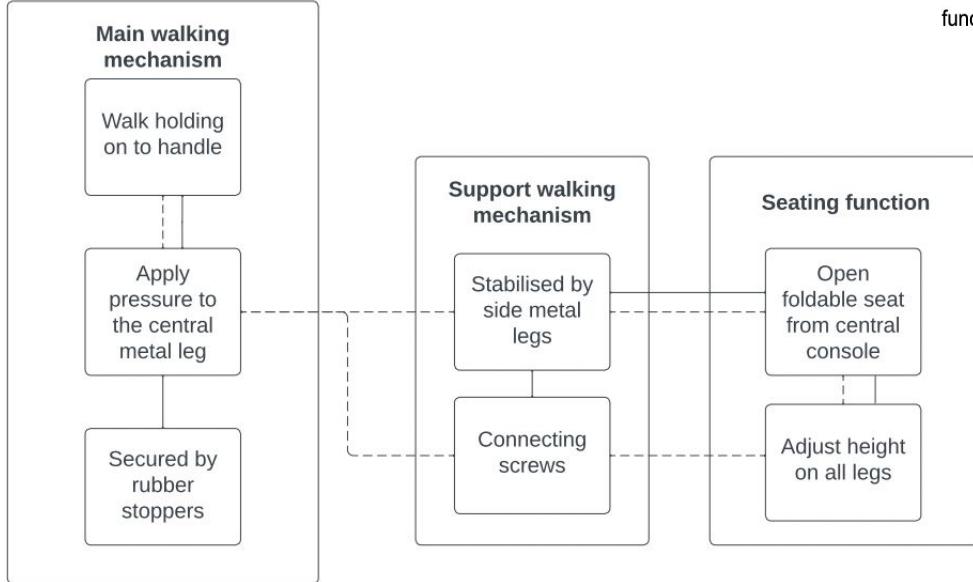
## MEAM514 Customer Needs Form

Customer name:	Odette
Approximate age:	85
Gender:	Female
Other demographic info:	Knee injury impaired walking ability
Interviewer(s):	Thaer Alaggad
Date:	4/2/23
Currently uses:	Walker
Type of user:	Daily

Question/prompt	Customer statement	Interpreted Need
Show me a common way you use your walking stick/walker.	Walker is resting against the wall across from the bed	Walking stick/walker must be simple to access
	User reaches over and unfolds walker, which seems to take effort.	Walking stick/walker must be easy to store.
	User places walker upright on the ground.	Walking stick/walker must be simple to deploy.
	User holds handles of walker and uses it to prop themselves up.	Walking stick/walker must be robust and durable.
	User walks a few paces using the walker.	Walking stick/walker helps user walk more comfortably.
How else do you use your walking stick/walker	Walker has place where user can sit if they're required to be stationary for long periods.	Walking stick/walker should accommodate seating.
	Walker has a compartment to store goods	Walking stick/walker should have storage compartments.
What do you like about your walking stick/walker	Walker is lightweight for its size.	Walking stick/walker must be lightweight.
	It is foldable and easy to store.	Walking stick/walker must be easy to store.
	It takes some of the load off user's legs when walking.	Walking stick/ walker aids in walking
What do you dislike about your walking stick/walker	It is sometimes too large to use in cramped or crowded spaces.	Walking stick/walker is compact.
	The wheels sometimes get in the way of walking on more uneven terrain.	Walking stick/walker must be versatile
Non-verbal observations	User needed some help when unfolding the walker.	Walking stick/ walker must be easy to operate alone.
	User needs assistance from other people when using the stairs as walker does not work.	Walking stick/ walker can be used on stairs.
	User gets tired quickly when walking and is always looking for a seat.	Walking stick/ walker has an option for resting on demand.
	User sometimes opts for using cane instead due to smaller form factor.	Walking stick/ walker must be compact.

# Product Architecture

Product Architecture Diagram



This product has two distinct modular features with several integral components being a part of these features. The first modular feature is the walking stick feature which includes the handle, rubber stoppers and the central metal leg. The second modular feature is the seating function which is composed of the plastic central seat and the two supporting metal legs. The central leg, supporting leg and seat are combined together with screws.

Both of these modular features are integrated into one product. This approach is good for this product as the number of components have been minimized, and each part has a specific function to do. There are no redundant parts present.

# QFD

MEAM514	QFD Phase 1 Project: Walking Stick Date: 04/10/2023	Product Weight capacity								+ Positive Correlation								
		Product Weight								- Negative Correlation								
		Product Height																
		Width of seat																
		Height adjustment distance	-		-													
		Diameter of stoppers																
		Time to convert from stick to seat		-														
		Engineering Metrics						Customer Perception										
		Customer Needs		Customer Weights		Product Weight capacity	Product Weight	Product Height	Width of seat	Height adjustment distance	Diameter of stoppers	Time to convert from stick to seat	Poor	2	3 Acceptable	4	5 Excellent	
		Walking stick is lightweight	3		1	9	1						C	A	B			
		Walking stick must be able to bear a lot of weight	9		9		3	3		1					AB	C		
		Walking stick must be adjustable	9						9					C	B	A		
		Walking stick must be stable to use	3							9					C	AB		
		Walking stick must have a comfortable seat	9					9		3					AB	C		
		Walking stick must be easy to switch from stick <-> seat	9								9			C	AB			
		Technical Benchmark		Units		kg	kg	cm	cm	cm	cm	s						
				EM Direction		LIB	SIB	SIB	LIB	NOM	NOM	SIB						
				A: Honmido Adjustable stick		95.20	2.18	79.50	38.00	18.20	4.60	18.00						
				B: Ta-Da walking stick pro		80.00	0.91	85.00	15.00	8.30	3.90	28.00						
				C: Hammock Seat Cane		114.00	1.34	88.90	29.21	12.40	5.20	35.00						
				Raw Score		84	27	30	108	81	63	81						
				Relative Weight		18%	6%	6%	23%	17%	13%	17%						
				Rank		2	7	6	1	3	5	3						
		Technical targets				100	1	80	40	20	5.0	15.0						

# QFD

MEAM514

QFD Phase 1

Project: Walking Stick

Date: 04/10/2023

Engineering Metric	Phase 1 Weight	Components				
		Tube material	Connecting mechanism	Seat Material	Folding Mechanisms	Stopper Material
Product Weight capacity	18%	9	3	9		
Product Weight	6%		3		3	
Product Height	6%		3		3	
Width of seat	23%			9	9	
Height adjustment distance	17%	9				
Diameter of stoppers	13%				9	
Time to convert from stick to seat	17%			9		

Raw Score	3.1	0.9	3.6	3.9	1.2
Relative Worth	24%	7%	28%	31%	9%
Rank	3	5	2	1	4

# Preliminary Cost Estimate

Target Production Cost	\$ 30.00
Design Budget	\$ 200,000

Component	Relative Worth	Target Cost	Estimated Cost	Relative Cost	Cost/Worth	Cost Overrun	Design Budget
Tubing	30%	\$ 9.00	\$ 6.00	20%	0.7	\$3.00	\$ 60,000
Molded Feet	6%	\$ 1.70	\$ 1.50	5%	0.9	\$0.20	\$ 11,321
Fabric cover	17%	\$ 4.98	\$ 5.25	18%	1.1	(\$0.27)	\$ 33,208
Folding Mechanisms	27%	\$ 8.21	\$ 11.00	37%	1.3	(\$2.79)	\$ 54,717
Seat Tension Mechanism	20%	\$ 6.11	\$ 5.00	17%	0.8	\$1.11	\$ 40,755
	0						
Total	100%	\$ 30.00	\$ 28.75	96%			\$ 200,000
Cost Overrun			\$ (1.25)	-4%			

Relative Worth: From QFD Phase 2

Target Cost: Relative Worth x Target Production Cost

Estimated Cost: From BOM cost estimation exercise

Relative Cost: Estimated cost x Relative Worth

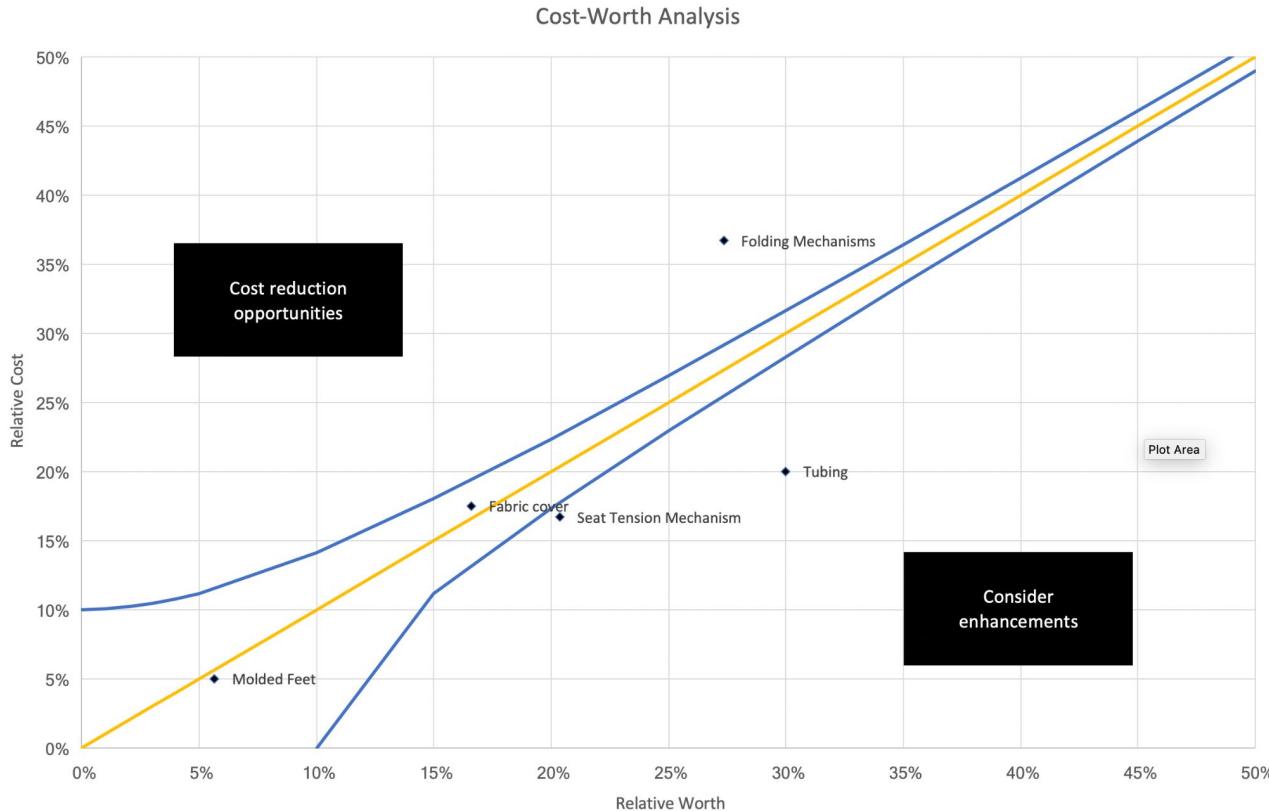


Cost/Worth: Relative Cost / Relative Worth

Cost Overrun: Target Cost - Estimated Cost

Design Budget: Relative Worth x Design Budget

# Cost Worth Analysis



# Product Specification

<b>Product Name</b>	SitStick
<b>Product Description</b>	The product is a walking cane that turns into a stool with the help of a foldable seat. It provides a comfortable seat to rest on when open, and a sturdy support cane when closed. It is manufactured with sturdy aluminum tubing and hence is strong and lightweight. The seat has a large area and is padded for comfort. The handle has a comfortable rubber grip and has an anti-bacterial coating on the surface that prevents germ buildup.

## General Characteristics

Metric	Target Value	Units
Dimensions (when folded)	840 x 300 x 60 (LxWxH)	mm
Cane height	840 - 940	mm
Weight	1.5	kg
Weight capacity	135	kg
Seat dimensions	280 x 230	mm

## Performance

Metric	Target Value	Units
Height adjustment distance	100	mm
Height adjustment steps	5	steps
Tube diameter	25.4	mm
Tube thickness	2	mm
Tube material	Aluminum	
Seat material	PP	units
Handle material	PP	

## Compliance, Serviceability, Safety

Metric	Target Value	Units
Stopper diameter	40	mm
Stopper material	Rubber	
Anti-bacterial coating on handle	ISO 22196 (JIS Z 2001) - checked from pcimag	

# BOM

## SitStick BOM & Cost Model

Preliminary Cost Estimate							
Line #	Part Name	Part Number	Qty	Source	Low Est.	High Est.	Notes and references
1	SitStick						
2							
3							
4	Handle S/A						
5	Handle		1	CM	0.439	0.527	Rule of thumb, molded from PP, ~366g, \$1.2/kg for PP
6	Extender		1	Home Depot	0.694	1.157	1" pipe, 0.15" thick. Based on 5 pack aluminum tubing from home depot
7	Handle S/A Total				1.133	1.684	
8							
9	Seat S/A						
10	Middle Seat		1	Statista	0.226	0.271	Rule of thumb, molded from PP, ~188g, \$1.2/kg for PP
11	Side Seat		2	Statista	0.091	0.109	Rule of thumb, molded from PP, ~76g, \$1.2/kg for PP
12	Seat Hinges		4	Statista	0.010	0.012	Rule of thumb, molded from PP, ~2g, \$1.2/kg for PP
13	Sliding Ring		1	Statista	0.004	0.004	Rule of thumb, molded from PP, ~3g, \$1.2/kg for PP
14	Seat Supports		1	Business Insider	0.047	0.061	Rule of thumb, Laser cut from Aluminum, ~20g, \$2.35/kg
15	Hinge Screws		8	Accu	1.440	2.400	M3 50 MM taperhead screws estimated from 50 pack
16	Sliding Screws		3	Accu	1.206	2.010	M6 Bolt estimated from 100 pack
17	Nuts		3	Fastenal	0.054	0.090	M6 Nut estimated from 100 pack
	Connecting rod		1	Grainger	3.610	2.527	Estimated from stainless steel rod grainger
18	Seat S/A Total				6.687	7.484	
19							
20	Legs S/A						
21	Leg Pieces Lower		2	Statista	0.096	0.115	Rule of thumb, molded from PP, ~40g, \$1.2/kg for PP
22	Leg Pieces Upper		2	Statista	0.094	0.112	Rule of thumb, molded from PP, ~39g, \$1.2/kg for PP
23	Cap Pieces		2	Business Insider	0.033	0.043	Rule of thumb, Laser cut from Aluminum, ~7g, \$2.35/kg
24	Legs S/A Total				0.223	0.270	
25							
26	Core S/A						
27	Core Tube		1	Home Depot	2.776	4.626	1" pipe, 0.125" thick. Based on 5 pack aluminum tubing from home depot
28	Snap Buttons		2	McMaster	1.519	3.038	10 pack 1/8" snap button, low is divided by 2
29	Base		1	Statista	0.025	0.033	Molded from Rubber sold at \$1.57/kg
30	Plastic Covering		1	Statista	1.725	2.070	Rule of thumb, molded from PP, ~345g, \$1.2/kg for PP
31	Screws		3	Amazon	0.288	0.480	M3 15 MM taperhead screws
32	Stopper		1	Statista	0.002	0.002	Molded from Rubber sold at \$1.57/kg
33	Core S/A Total				6.334	10.249	
34	<b>MATERIAL COST TOTAL</b>				<b>14.38</b>	<b>19.69</b>	
35							
36	<b>PRODUCT ASSEMBLY</b>		1				
37	Handle S/A Assembly		1	CM	0.125	0.19	0.5 min @ \$15/hr, high is 50% higher
38	Seat S/A Assembly		1	CM	0.500	0.75	2 min @ \$15/hr, high is 50% higher
39	Legs S/A Assembly		1	CM	0.500	0.75	2 min @ \$15/hr, high is 50% higher
40	Core S/A Assembly		1	CM	0.125	0.19	0.5 min @ \$15/hr, high is 50% higher
41	Main Assembly		1	CM	0.750	1.13	3 min @ \$15/hr, high is 50% higher
42							
43	<b>PRODUCT ASSEMBLY TOTAL</b>				<b>2.00</b>	<b>3.00</b>	
44							
45	<b>TOTALS</b>				<b>20.47</b>	<b>28.36</b>	