



# Problem Definition

Creating a more user friendly hands-free door opener

Presentation created by Team Nugget

Presented by:

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# Problem Definition Update

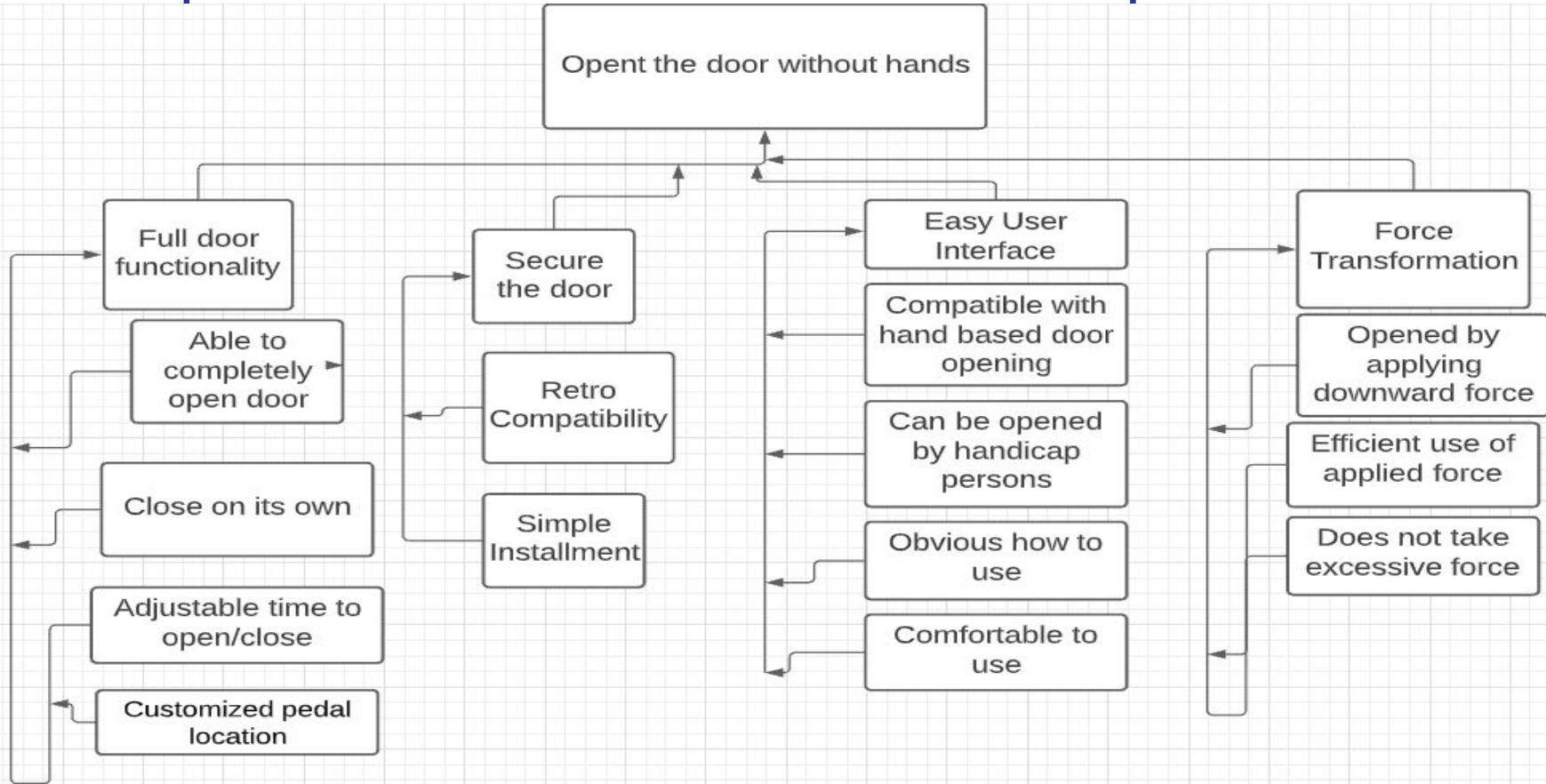
Specified our product idea:

“Product” → “Foot Operated Hydraulic Unit”



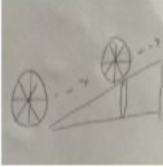

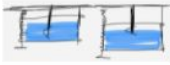
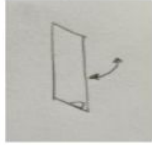

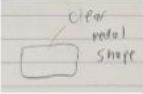


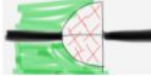

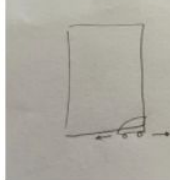
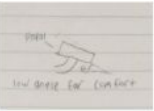
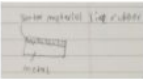




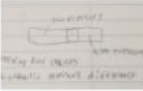

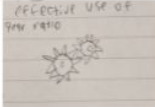
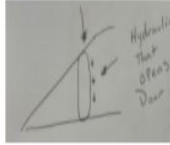
- “Hands-free” limits to operation with either torso, head, legs or feet and having our product be **foot operated was most convenient** for consumers
- Having the product incorporate hydraulics means that it **functions similar to current door closers** and **remains purely mechanical**.



# Concept Generation - Functional Decomposition



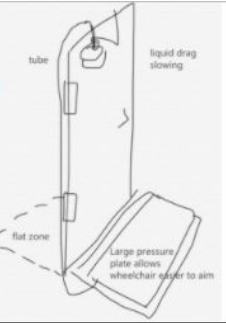
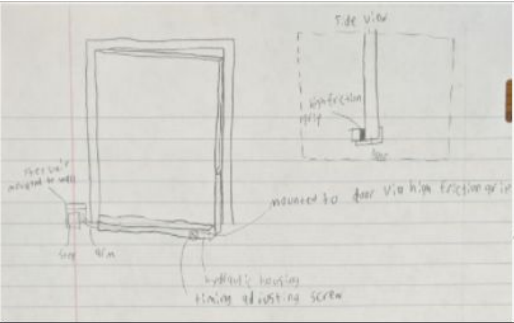
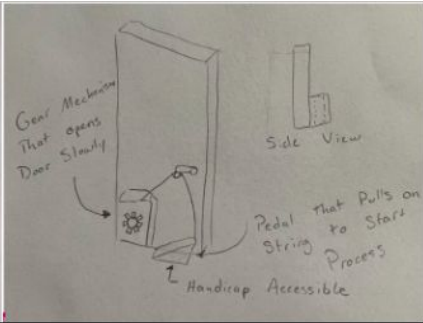
# Concept Generation Overview

<p>Can be opened by handicapped persons</p>					<p>Adjustable time to open/close</p>				
<p>Obvious how to use</p>					<p>Customized pedal location</p>				
<p>Comfortable to use</p>					<p>Opened by applying downward force</p>				
<p>Closes on its own after opening</p>					<p>Efficient use of applied force</p>				

# Concept Selection

## 1. (House of Quality)

2



3

4

5

Customer Requirements

Weights

Effort to open the door (low)	4	1	1	1	1
Ease of operating the door (easy)	5	1	1	1	1
Time required to operate door (short)	3	0	-1	1	0
Space filled by unit (small)	2	1	-1	0	-1
Ease of installation (easy)	3	0	0	0	0
Low Cost (low)	4	0	-1	-1	-1
Durability (durable)	5	0	0	0	1
Aesthetically pleasing (good)	1	0	-1	0	1
Ease of repair (easy)	2	0	-1	-1	0
Safe to operate (safe)	4	1	1	1	1
Retro-Compatibility (compatible)	2	1	1	1	1
Quiet (true)	1	1	-1	1	1
Purely Mechanical (true)	1	1	1	1	1
Customizability of door operation time	1	1	1	0	1
<b>Total +</b>		8	6	7	9
<b>Total -</b>		0	-6	-2	-2
<b>Overall Total</b>		8	0	5	7
<b>Weighted Total</b>		20	4	14	18

GOOD

BAD

NOT SO BAD

NOT SO GOOD

# Description of Final Product and Prototype

- Pressure Plate

- Casing, Plate, Spring, Fluid bag

- Fluid Tube

- Force Transformation Device: Linear to Rotation

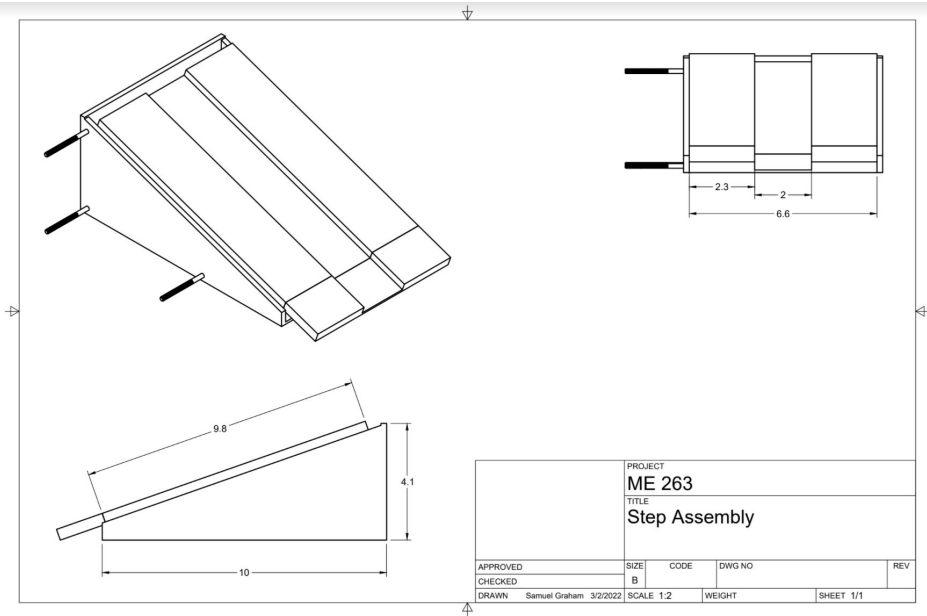
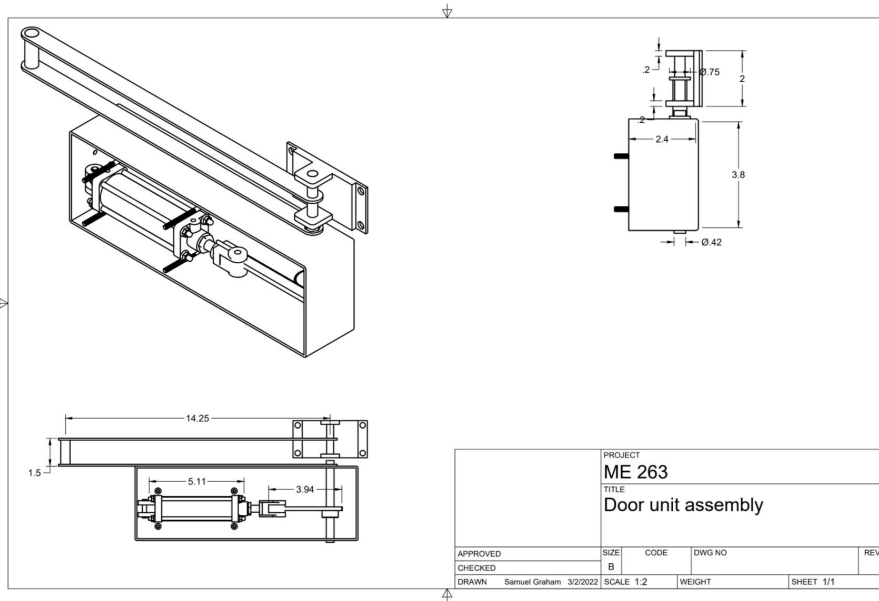
- Piston, Gear, Gear Rack, Casing, Shaft
- Scissor Arm
  - Two Arms, Connecting Pins, Pivot Mount

- Resistance Fluid Tank

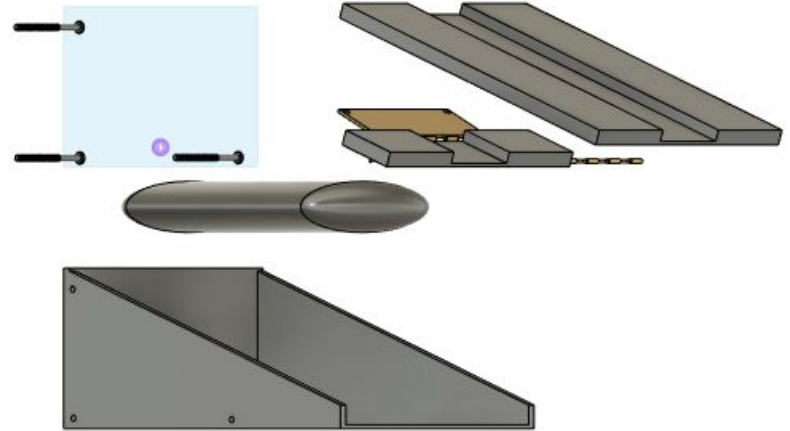
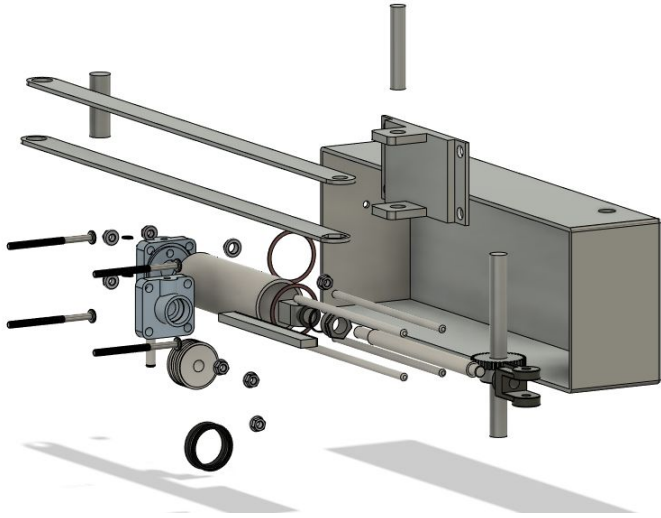
- Casing, Shaft, Fluid Fins, Fluid.



# Description of Final Product and Prototype (Cont.)

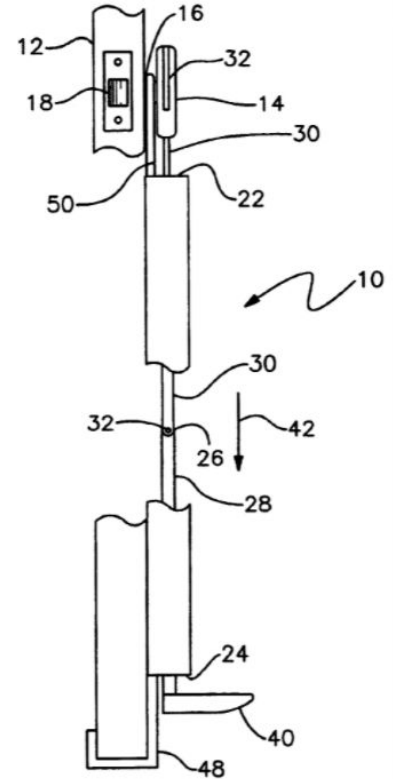
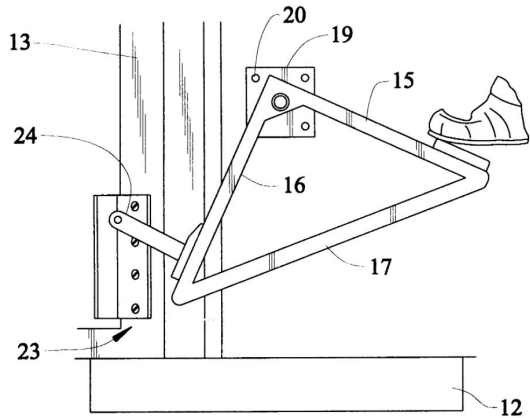


# Description of Final Product and Prototype (Cont.)





# Comparison to Relevant Benchmarks and Patents



# Bill of Materials

Item No.	Part No.	Part Name	Units	Qty	Material / Description	Source	Catalog No.	Unit Cost (\$)	Unit Processing Cost (\$)	Assembly Cost (\$)	Line Total Cost (\$)	List Price (\$)
0100	0101	Pressure plate	m*m	1	Aluminum Alloy / Where people will step on	Custom	N/A	0.82	0	0.1	0.92	3.28
Pressure plate triggering and force transformation	0102	Spring	N/m, pcs	2	stainless spring steels / reset the pressure plate and close the door	The Spring Stor	PC060-296-350	0.46	0	0.1	1.02	1.84
	0103	Fluid Bag	in^2	1	Rubber / Shoots the fluid out due to the force of the pressure plate	Custom	N/A	7.26	1.5	0.1	8.86	29.02
	0104	Long tube	ft	1	Rubber / transfer fluid to top	Lowe's	Item #814315	1.89	0	0.1	1.99	7.55
	0105	Hydraulic Fluid	Liters	4.68	mineral-based fluids / transfer the force	Grainger	DTE 24	2.81	0	0.1	13.24	11.23
0200	0201	Main casing	m*m*m	1	stainless steels / hold the components	Custom	N/A	1.68	5	0.1	6.78	6.71
Door opening	0202	Main casing screws	pcs	4	stainless steels / connect to the door	Grainger	G2584	0.01	0	0.1	0.13	0.03
	0203	Piston pack - arm	pcs	1	stainless steels / push the gear rack	Custom	N/A	0.15	3	0.1	3.25	0.60
	0204	Piston pack - cylinder	pcs	1	stainless steels / hold the arm and the fluid	Custom	N/A	0.79	3	0.1	3.89	3.17
	0205	Piston pack - seal ring	mm	1	Rubber / seal the fluid	Shadow Trailer	#DBC-225-SE	1.00	0	0.1	1.10	3.99
	0206	Piston pack - screws	pcs	3	stainless steels / secure the cylinder to casing and gear rack	Grainger	G2584	0.01	0	0.1	0.12	0.03
	0207	Piston pack - nut	pcs	3	stainless steels / secure the screws	Grainger	447J35	0.80	0	0.1	2.51	3.22
	0208	Gear rack	mm	1	stainless steels / transfer linear motion	McMaster-Carr	2485N242	5.39	0	0.1	5.49	21.54
	0209	Large gear	pcs	1	stainless steels / transfer linear motion to rotational motion	McMaster-Carr	5172T16	10.73	0	0.1	10.83	42.92
	0210	Main shaft	mm	1	stainless steels / transfer the force from gear to arms	Custom	N/A	0.11	2	0.1	2.21	0.45
	0211	Rotational Pushing Arm	pcs	2	stainless steels / rotate and push the door open	Custom	N/A	0.14	2	0.1	2.39	0.57
	0212	Connecting pin	mm	2	stainless steels / connect the arms together and to the door frame mount c	Custom	N/A	0.01	2	0.1	2.12	0.03
	0213	Door frame mount case	pcs	1	stainless steels / allows the arm connect to the door and rotate	Custom	N/A	0.71	5	0.1	5.81	2.82
	0214	Door frame mount Screws	pcs	4	stainless steels / secure the case	Grainger	G2584	0.01	0	0.1	0.13	0.03
	0300	0301	Small gear	pcs	1	stainless steels / drive the slowing device	McMaster-Carr	5172T12	6.72	0	0.1	6.82
Door Closing	0302	Fluid tank	pcs	1	stainless steels / hold the liquid	Custom	N/A	5.12	5	0.1	10.22	20.48
	0303	Shaft	mm, pcs	1	stainless steels / drive the drag fin bars	Custom	N/A	0.11	2	0.1	2.21	0.45
	0304	Drag fins	pcs	4	stainless steels / create drag in fluid	Custom	N/A	0.04	2	0.1	2.27	0.17
	0305	Fin bars	pcs	4	stainless steels / hold the fins together and prevent opening to large	Custom	N/A	0.95	4	0.1	7.88	3.78
	0306	Long screws	pcs	2	stainless steels / adjust the height of the tank	Grainger	6JA46	0.07	0	0.1	0.23	0.26
	0307	Nut	pcs	2	stainless steels / hold the screws	Grainger	22UK82	0.00	0	0.1	0.11	0.02
	0308	Spring	N/m, pcs	2	stainless spring steels / secure the tank on the long screws	The Spring Stor	PC060-296-350	0.30	0	0.1	0.70	1.20
	0309	Drag Fluid	Liters	4.68	mineral-based fluids / source of drag	Grainger	DTE 24	2.85	0	0.1	13.45	11.41
	0400	0401	Final Assembly	-	1	Final assembly of all parts	-	-	-	-	5.00	5.00
Assmeblies	0402	Pressure plate assy	-	1	Assembly of the step plate	-	-	-	-	3.00	3.00	
	0403	Door opening assy	-	1	Assembly of door opening mechanism	-	-	-	-	3.50	3.50	
	0404	Door closing assy	-	1	Assembly of dor closing mechanism	-	-	-	-	3.50	3.50	

## Bill of Materials (cont.)

Total Purchased Parts \$	58.57
Total Custom Manufactured Parts \$	58.80
Total Assembly Cost \$	15.00
Total Cost \$	131.67

# Financial Analysis - Values

Input		
Interest Rate / year	8	%
Analysis Periods / year	4	#
Tooling and Fixtures	419000	
Annual Production	19200	#
Estimated Purchased Parts	58.57	\$
Estimated Fabricated Parts	58.8	\$
Estimated Assembly Cost	15	\$
R&D Costs	134264	\$
Cost % of Retail	25	%
Return to Project % of Retail	30	%

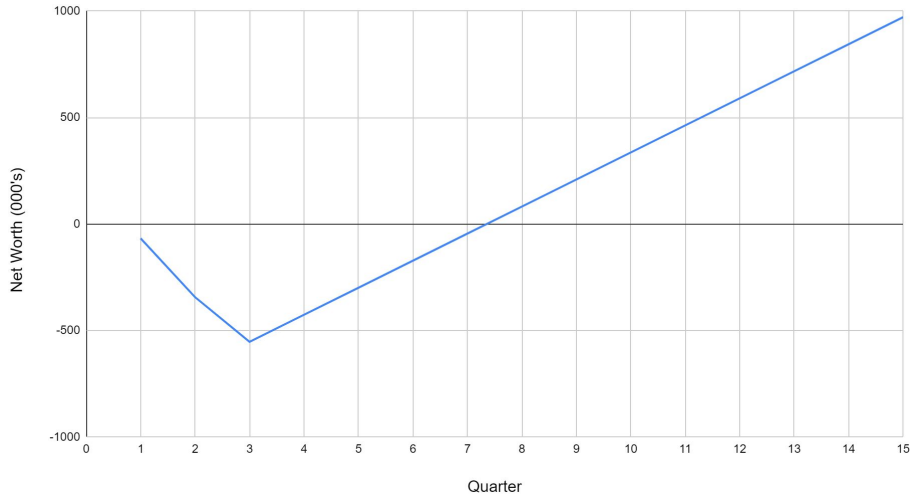
Calculated		
Interest Rate per Period	0.02	rate/period
Estimated Mfg. Cost	132.37	\$
Retail Price	529.48	\$
Build per Period	4800	#
Total Program Build	57600	#
Total Retail Sales	30498048	\$
Return to Project	9149414.4	\$
Net Present Value	737.23	\$(000)
Net Worth (excl. interest)	971.64	\$(000)

ROI=	46.83	% per year	Min production with no interest=	1741
ROR=	69.19	% per year	Min production with interest=	2005
PB=	8th	Quarter		
NPV=	737.23	\$(000)		

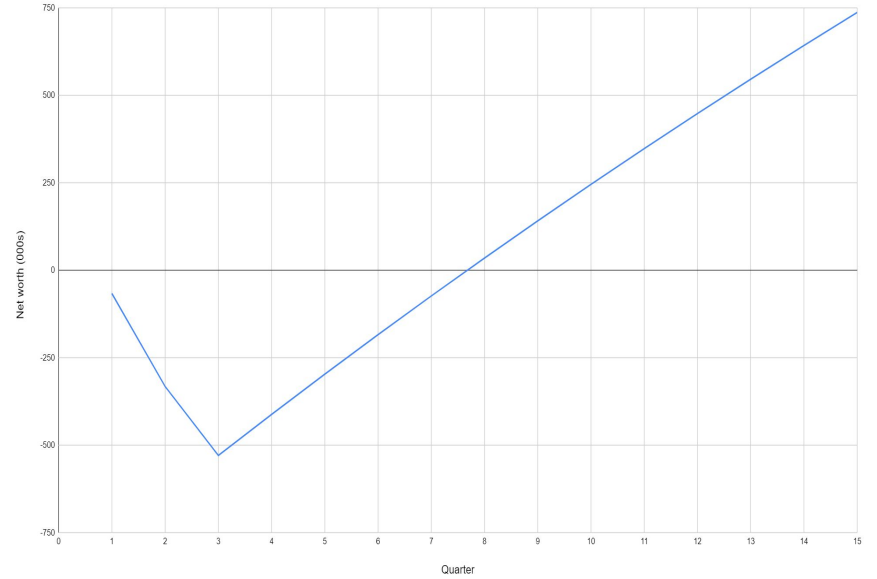


# Financial Analysis - Net Worth Charts

Net worth per Quarter (no interest)



Net worth per Quarter (w/ interest)









# Conclusion and Recommendation

## Key takeaways

- Product is financially feasible
- Despite high unit cost, still under some competitors

## Moving Forward

- Further iterate and enhance design
- Fabricate and analyze prototype





The background is a solid pink color. In the top right corner, there is a decorative graphic consisting of several overlapping geometric shapes, including triangles and squares, in various shades of pink and magenta.

Questions?