



Regenerative Braking Electric Skateboard

ENTREPRENEURSHIP SENIOR DESIGN PROJECT

FAWZI AL HADRAB – BRAD GEORGE – BRENDAN DEJONGE – RYAN HAWKINS

Electric Skateboard Safety and Performance

Problems:

Unreliable Brakes

No Braking When Fully Charged

Low Distance

Manual Truck System

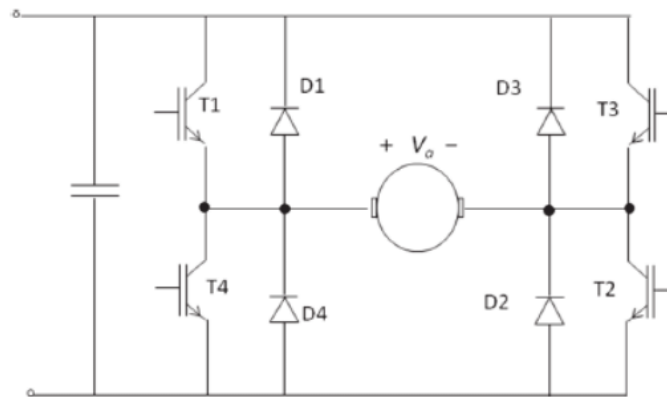
Improvements to Regenerative Braking System

Adaptive Truck System

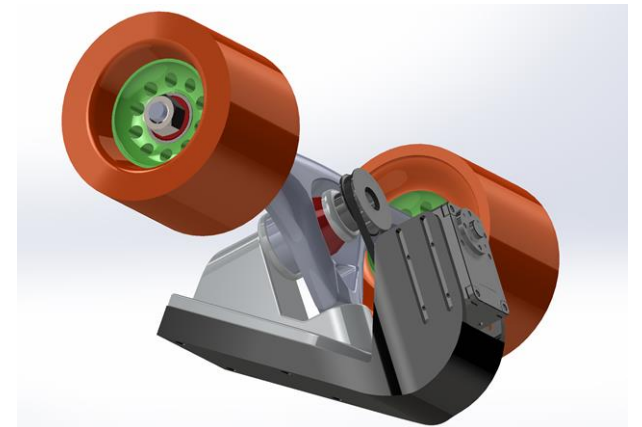
Solutions:



Digikey.com



Researchgate.net



Target Customers



FitNish Media on Unsplash



Electric skateboard industry – \$2.4 B by 2025 – askwonder.com



Electric scooter market - \$19.4 B - grandviewresearch.com



Target customers would city commuters currently using skateboards, E-scooters, or E-bikes.

MVP

Form fitting weatherproof enclosure

Custom TPU gaskets and shock pads



Carbon fiber reinforced nylon motor mounts

Dual synchronized 180kv motors

Anti-spark switch

Customized Vedder Electric Speed Controller

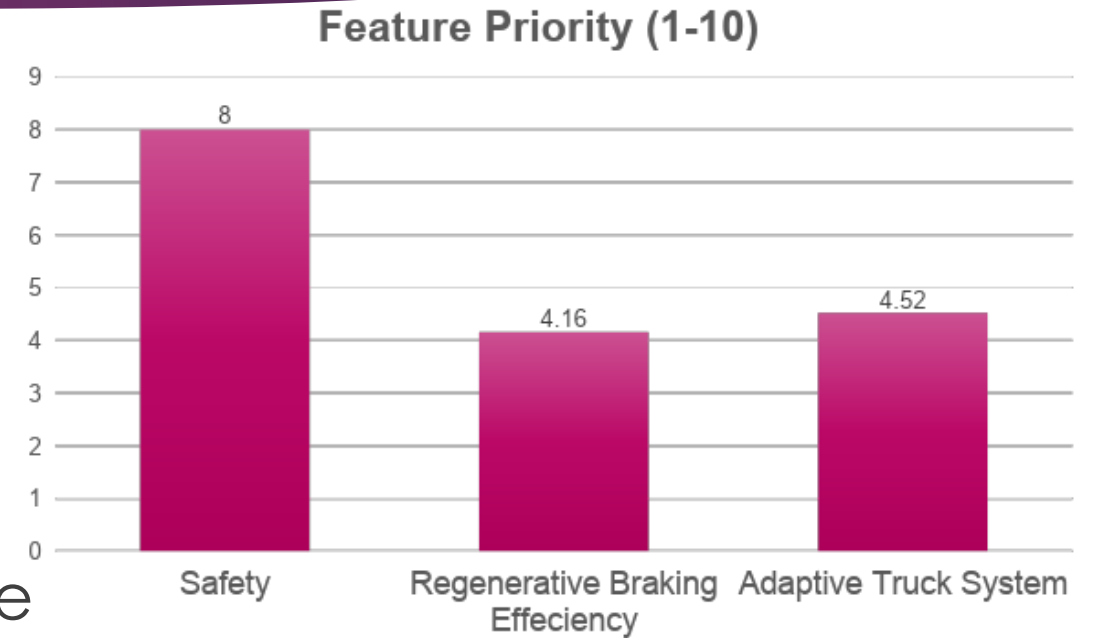
Customer Feedback

Who Was Contacted

- ▶ 10 in-person surveys
- ▶ 39 responses online

Feedback Goals

- ▶ Establish potential customer stereotype
- ▶ Find out what potential customers value most
- ▶ Gather feedback on MVP's current progress



Key Takeaways



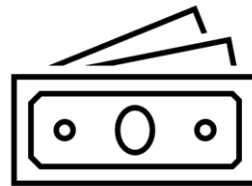
Prioritize safety



Range adds a lot of value



Adaptive truck system should be a safety feature



Feature	Price Addition
Reliable Brakes	≈ \$100
Adaptive Trucks	≈ \$150
Increased Range	≈ \$200-\$400

Competitive Analysis

	Boosted Boards – Stealth	Mellow Boards – Mellow Cruiser	Evolve Skateboards - Hadrean	Kaly.nyc – XL-R (Offroad Board)	Us
Truck System	Manual	Manual	Manual	Automatic hydraulic dampers	Automatic adjustment
Braking Reliability	Mostly reliable	Overloads, no braking above 30 MPH	Brakes/wheels can lock up	Overheats	Will not overload, reliable
Braking When Fully Charged	No	Yes	No	No	Yes
Distance	6-7 Miles	7.5-10 Miles	35-40 Miles	60-90 Miles	35-40 Miles
Price	\$1,600	\$2,300	\$2,500	\$6,350	\$3,000

Go-To-Market Plan

Now	Phase 1	Phase 2	Phase 3	Phase 4
Rough MVP	<ul style="list-style-type: none">1-3 more years of Senior DesignRefine design, shift from “working” to “sellable”	<ul style="list-style-type: none">Manufacture first batchGather feedback and improve	<ul style="list-style-type: none">Begin producing in larger numbers	<ul style="list-style-type: none">Refine manufacturing

10 Sales

25 Sales

50 Sales

\$5,000 From CSU

\$10,000 From Owner or CSU Funding

\$50,000 in Loans

Sales Plan	Year 1	Year 2	Year 3
Quantity Sold	10	25	50
Unit Sale Price	\$3,000	\$3,000	\$3,000
Unit Material Cost	-\$1,800	-\$1,700	-\$1,600
Labor Cost Per Unit	-\$200	-\$200	-\$200
Shipping Cost Per Unit	-\$40	-\$40	-\$40
Profit	\$9,600	\$26,500	\$58,000

Financials

Profit and Loss	Year 1		Year 2		Year 3	
Revenue	\$30,000	100%	\$75,000	100%	\$150,000	100%
COGS	-\$20,000	-66.67%	-\$47,500	-63.3%	-\$90,000	-60%
Gross Profit	\$10,000	33.33%	\$27,500	36.67%	\$60,000	40%
Facility Costs	-\$5,000	-16.7%	-\$5,000	-6.67%	-\$5,000	-3.33%
R&D	-\$5,000	-16.7%	-\$5,000	-6.67%	-\$5,000	-3.33%
Website Costs	-\$1,000	-3.34%	-\$1,000	-1.33%	-\$1,000	-0.67%
Salary	-\$32,000	-106.7%	-\$32,000	-42.67%	-\$32,000	-21.33%
Marketing	-\$500	-1.67%	-\$1,500	-2%	-\$2,500	-1.67%
Shipping Costs	-\$200	-0.67%	-\$500	-0.67%	-\$1,000	-0.67%
EBITDA	-\$33,700	-112.3%	-\$17,500	-23.33%	\$13,500	9%
Depreciation	-\$200	-0.67%	-\$200	-0.33%	-\$200	-0.1%
Interest	\$2,000	-6.67%	\$2,000	-2.67%	\$2,000	-1.33%
Net Income	-\$35,900	-119.67%	-\$19,700	-26.33%	\$11,300	7.5%

Balance Sheet	Day 1	Year 1	Year 2	Year 3
Assets				
Cash	\$59,000	\$23,300	\$3,800	\$15,300
Machinery	\$1,000	\$1,000	\$1,000	\$1,000
Accum Depr		-\$200	-\$400	-\$600
Total Assets	\$60,000	\$24,100	\$4,400	\$15,700
Liabilities				
Loan	\$50,000	\$50,000	\$50,000	\$50,000
Equity				
Contribution	\$10,000	\$10,000	\$10,000	\$10,000
Earnings		-\$35,900	-\$55,600	-\$44,300
Total Equity	\$10,000	-\$25,900	-\$45,600	-\$34,300
Liability + Equity	\$60,000	\$24,100	\$4,400	\$15,700

Cash Flow	Day 1	Year 1	Year 2	Year 3
Net Profit		-\$35,900	-\$19,700	\$11,300
Depreciation		\$200	\$200	\$200
Cash from Op		-\$35,700	-\$19,500	\$11,500
Asset Purchases	-\$1,000			
Loan	\$50,000			
Owner Contr	\$10,000			
Change in Cash	\$59,000	-\$35,700	-\$19,500	\$11,500
Beginning Cash		\$59,000	\$23,300	\$3,800
Ending Cash	\$59,000	\$23,300	\$3,800	\$15,300

Lean Canvas

Problem 1. Unreliable brakes 1. Adjusting truck sensitivity 1. Signal noise interference	Solution 1. Safe, reliable brakes 1. Adaptive trucks 1. Signal filtering	Unique Value Proposition Maximized safety and reliable, efficient braking	Unfair Advantage Adaptive truck system patent Custom R&D	Customer Segments Skateboard enthusiasts Small EV city commuters
	Key Metrics Reliability (problems per hour rode) Orders		Channels Direct sales via website	
Cost Structure Net \$60,000 starting cost Year 1: Yearly Net Income = -\$35,900 Year 2: Yearly Net Income = -\$19,700 Year 3: Yearly Net Income = \$11,300			Revenue Streams \$3,000 price point for online sales Year 1: 10 Sold = \$9,600 Profit Year 2: 25 Sold = \$26,500 Profit Year 3: 50 Sold = \$58,000 Profit	

What Next?

1-3 more years of Senior Design
before market ready “Minimum
Loveable Product”

Fantastic Senior Design Project full
of incredible learning opportunities,
but poor business outlook

Special Thanks

Thank you for the funding!

Thank you to our awesome mentors

- ▶ Special Thanks to Ian Bernstein
- ▶ Bob Thelen
- ▶ Bert Vermeulen

Additional
Slides

Problems

Problems:

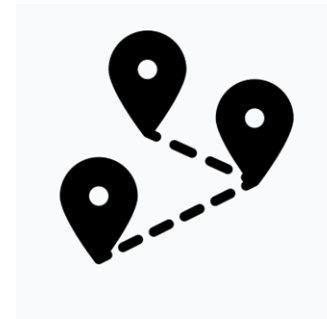
Unreliable
Brakes



No Braking
When Fully
Charged



Low
Distance



Manual Truck
System



Safety Issues

Other Small Electric Vehicle Competitive Analysis

	Segway – Ninebot KickScooter MAX	Segway – eMoped C80 (no license)	Trek – Verve+ 2	Evolve Skateboards - Hadrean	Us
Safety	2/5	4/5	5/5	3/5	5/5
Top Speed	18 mph	20 mph	22 mph	31 mph	35 mph
Weight	31 lbs	NA	51 lbs	27 lbs	30 lbs
Comfort	3/5	5/5	4/5	2/5	3/5
Distance	40-45 Miles	47-52 Miles	49-55 Miles	35-40 Miles	40-45 Miles
Price	\$950	\$2,200	\$2,850	\$2,500	\$3,000

Competitive Analysis

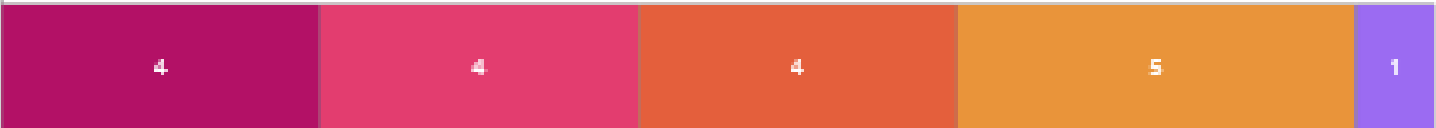
Safety Distance Price Comfort Weight

Segway - Ninebot KickScooter MAX



Total
19

Segway - eMoped c60



18

Trek - Verve+ 2



18

Evolve Skateboards - Hadrian



18

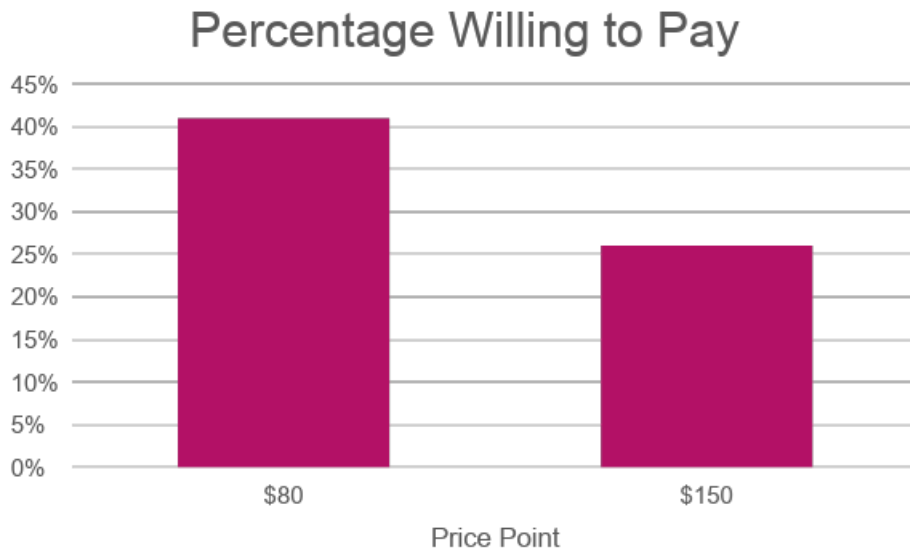
Us - Improved Skateboard



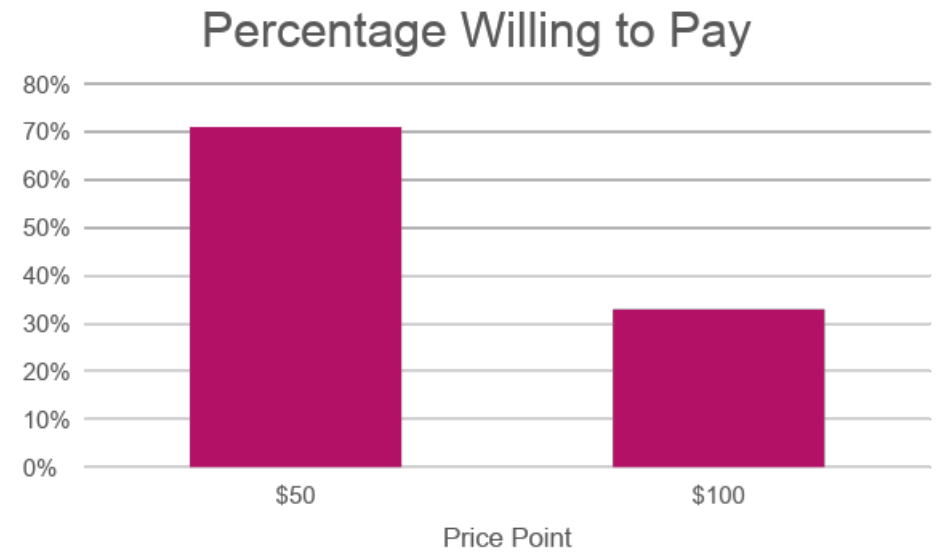
19

Price Point Willingness

Price Point for Truck System



Price Point for Braking Improvements



Channels and Revenue

Cost For MVP	Manufacture 10 Units	Manufacture 1000 Units
\$5,000 For 2 Prototypes Highly time intensive Constantly changing MVP Funded by CSU	\$15,000 for Materials \$5,000 for labor Shipping ≈ \$20-\$40 per board \$3,000 selling price direct to consumer (online sales only)	\$1,300,000 for Materials \$500,000 for labor Same shipping and price
-\$5,000 with need for further development before marketable	+\$30,000 -\$20,400 ≈\$9,600	+\$3,000,000 -\$1,850,000 ≈\$1,150,000

Sales will come from online sources only.

Bird.co 10k

	December 31,		
	2021	2020	2019
Revenues:			
Sharing	\$ 187,327	79,941	140,448
Product sales	17,815	14,660	10,076
Total revenues	205,142	94,601	150,524
Cost of sharing, exclusive of depreciation	101,061	71,628	153,646
Cost of product sales	17,340	22,716	20,319
Depreciation on sharing vehicles	47,335	23,791	112,234
Gross margin	39,406	(23,534)	(135,675)
Other operating expenses:			
General and administrative (including stock-based compensation expense of \$78.7 million, \$4.4 million and \$28.8 million for years ended December 31, 2021, 2020 and 2019, respectively)	209,998	152,910	192,063
Selling and marketing (including stock-based compensation expense of \$2.7 million, \$0.9 million and \$0.8 million for years ended December 31, 2021, 2020 and 2019, respectively)	17,906	18,404	16,656
Research and development (including stock-based compensation expense of \$5.2 million, \$0.9 million and \$1.2 million for years ended December 31, 2021, 2020 and 2019, respectively)	31,426	34,376	40,836
Tariff reimbursement	—	(24,986)	—
Total operating expenses	259,330	180,704	249,555
Loss from operations	(219,924)	(204,238)	(385,230)
Interest expense, net	(6,073)	(6,562)	(4,955)
Other income, net	29,873	2,634	2,979
Loss before income taxes	(196,124)	(208,166)	(387,206)
Provision for income taxes	209	64	276
Net loss	\$ (196,333)	\$ (208,230)	\$ (387,482)
Net loss per share attributable to common stockholders, basic and diluted	\$ (2.51)	\$ (5.57)	\$ (18.31)
Weighted-average shares used to compute net loss per share attributable to common stockholders, basic and diluted ⁽¹⁾	84,260,800	37,366,609	21,156,933

Lime Energy Co 10k

	Year ended December 31, 2015	Year ended December 31, 2014
Revenue	\$ 112,623	\$ 58,816
Cost of sales (1)	74,860	41,162
Gross Profit	37,763	17,654
Selling, general and administrative expense	35,077	20,195
Acquisition costs	1,941	—
Amortization of intangibles	\$79	—
Operating loss	(134)	(2,541)
Other Income (Expense)		
Interest income	193	100
Interest expense - Related Party \$1,221 and \$189 thousand for the year ended December 31, 2015 and 2014, respectively.	(1,313)	(189)
Extinguishment of debt - Related Party	(1,420)	—
Loss from change in derivative liability - Related Party	(996)	—
Total other expense	(3,536)	(89)
Loss from continuing operations before income taxes	(3,670)	(2,630)
Income tax benefit	1,147	—
Loss from continuing operations	(2,523)	(2,630)