

Maritime Drone Launcher



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Team Members



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Project Background and Inspiration

Zipline Drone And Launcher System



[1] TechGenez

Florida Law Enforcement Patrol Boat



[2] Pensacola News Journal



Significance



Why use fixed wing drones over multi-rotor drones?

- More efficient, resulting in longer flight times and larger payloads.
- Less complex.
- Fly at higher altitudes.

Benefits of a launcher system

- A significant percentage of a drone's energy consumption is used during takeoff.
- Provides the initial energy required to get the drone up to takeoff speed.
- Removes the need for a long runway for takeoff.



Need Statement

There is a large gap in technology between the military and commercial market when it comes to mid-sized, fixed wing drone launchers.

Objective

The objective of our project is to design a drone launching system capable of interfacing with various small watercraft used by the Florida Fish and Wildlife Conservation Commission (FWC) and other law enforcement organizations.



Targets and Metrics

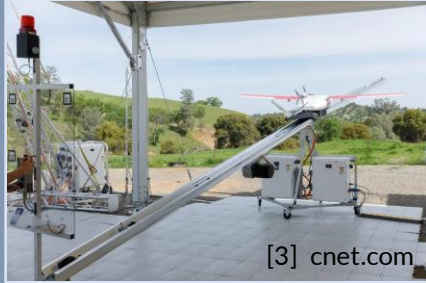
Function	Metric	Target
Cost	Price to Build Prototype	< \$2000
Portability	Weight	< 100 lb
Weather Resistance	Functional After Being Submerged	Yes/No
Stability	Stays Fixed to Boat When Launching	Yes/No
Launch Capability	Max Drone Weight	22 lb or 10kg
Launch Speed	Final Drone Speed	40 mph or 18m/s
Adjustability	Angle Adjustability	0 – 30 degrees

The targets are goals to be achieved by the system, and the metrics are the parameters to measure the targets.



Benchmarking

Zipline[1][5]



- Launcher Price: Unknown
- UAV Specs
 - Weight: 44 lbs
 - Payload: 4 lbs
 - Wingspan: 11 ft
- Launcher
 - Electric motor
 - 67 mph in 0.3 seconds

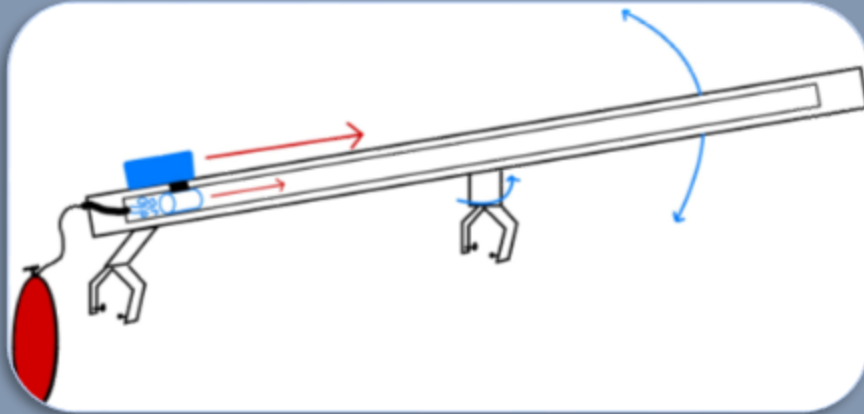
ElevonX[6]



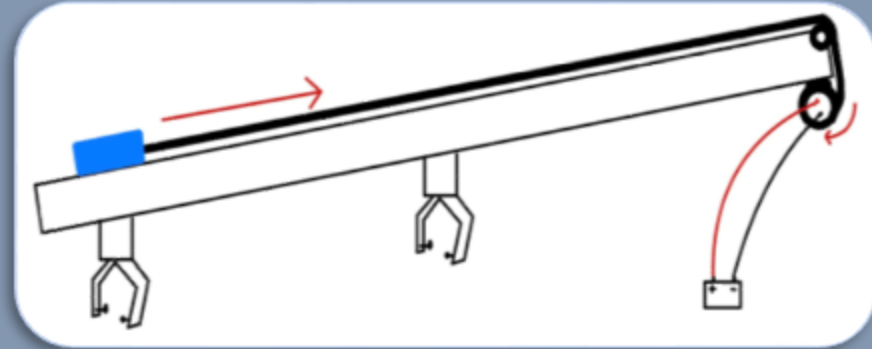
- Launcher Price: ~ \$4000 - \$6000
- UAV Specs
 - Weight: 13.8 lbs
 - Payload: 4.4 lbs
 - Wingspan: 7.5 ft
- Launcher
 - Elastic Bands
 - 22 lbs max take-off weight
 - Length: 7.87 ft
 - Weight: < 44 lbs
 - 44.7 mph
 - Aluminum/Stainless Steel



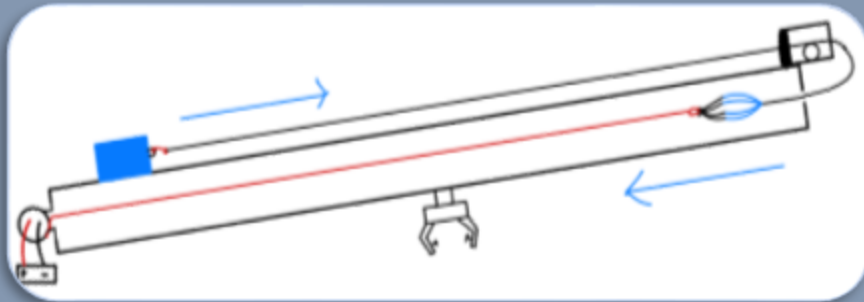
Concept Generation



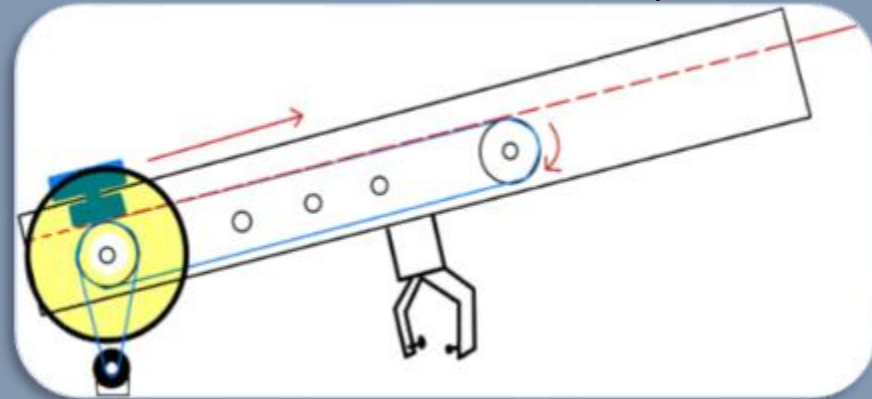
1. Gas Piston Concept



2. Electric Motor Concept



3. Elastic Bands Concept



4. Flywheel Concept



Concept Decision Matrix

		Ratings			
Criterion	Weight	Gas Piston	Electric Motor	Elastic Bands	Fly Wheel
Ease of Use	20	4	4	5	2
Durability	10	1	4	3	2
Ease of Manufacturing	10	1	5	5	4
Load Capacity	10	3	5	3	3
Safety	20	2	4	3	2
Weight	10	5	1	5	1
Power Consumption	5	5	1	4	3
Cost	15	4	1	5	4
Total	100	61	66	83	51

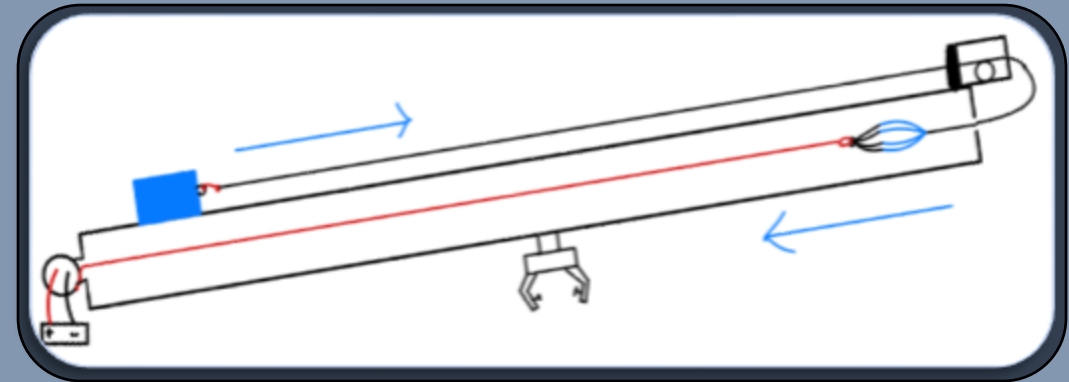
Ratings on a scale from 1 to 5: 1 = Poor & 5 = Excellent



Concept Selection

The elastic bands (**Concept 3**) showed the most promise by scoring the highest overall rating compared to the other concepts on the decision matrix. Below are some of the key factors which support the choice of this concept.

- **Man powered loading mechanism.**
 - No external power source.
 - Increased ease of use.
 - Increased resistance to wet environments.
- **Elastic band propulsion mechanism.**
 - Simplistic yet powerful launcher design.
 - Designed for maritime use.
- **Use of “off the shelf” components.**
 - Minimal custom fabrication.
 - Reduces the cost, manufacturing complexity, and maintenance difficulty.





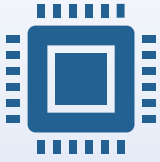
Modifications to Selected Concept

Original:

- Electric Motor
- Ratchet Strap Mount Design
- External Pulley Position
- No Rear Mount

Current:

- Hand Winch System
- C-Clamp Mount Design
- Inset Pulley Position
- Rear Mount

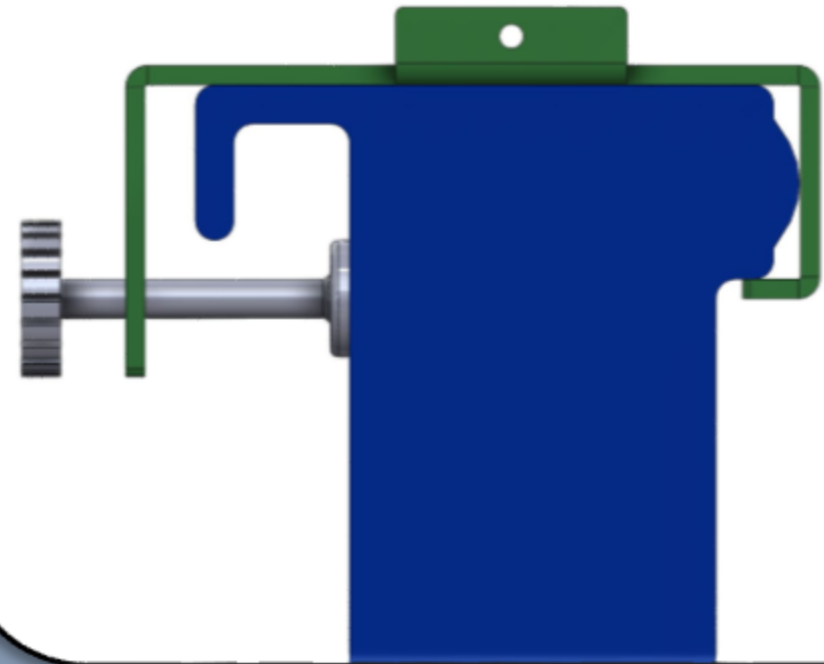


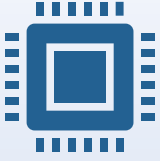
CAD Design

CAD Model of Launcher System



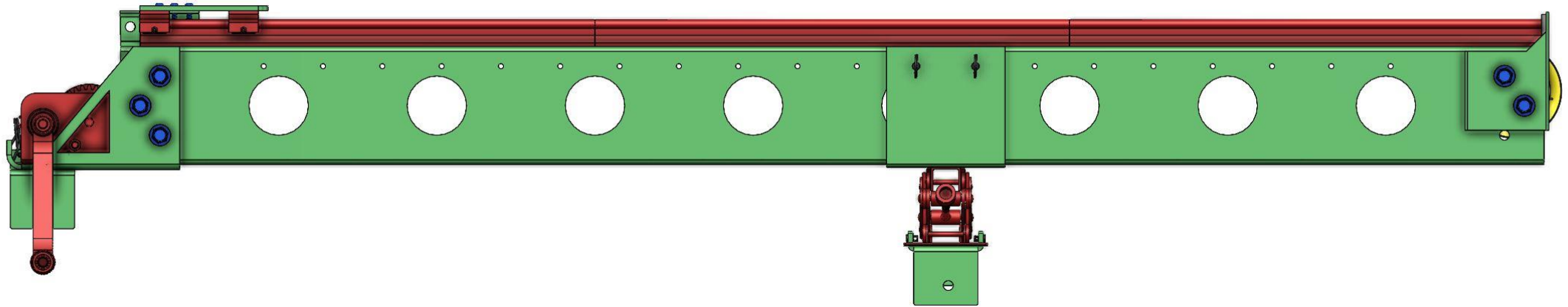
Gunwale Mounting Clamp

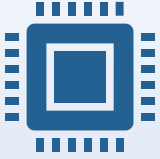




CAD Design

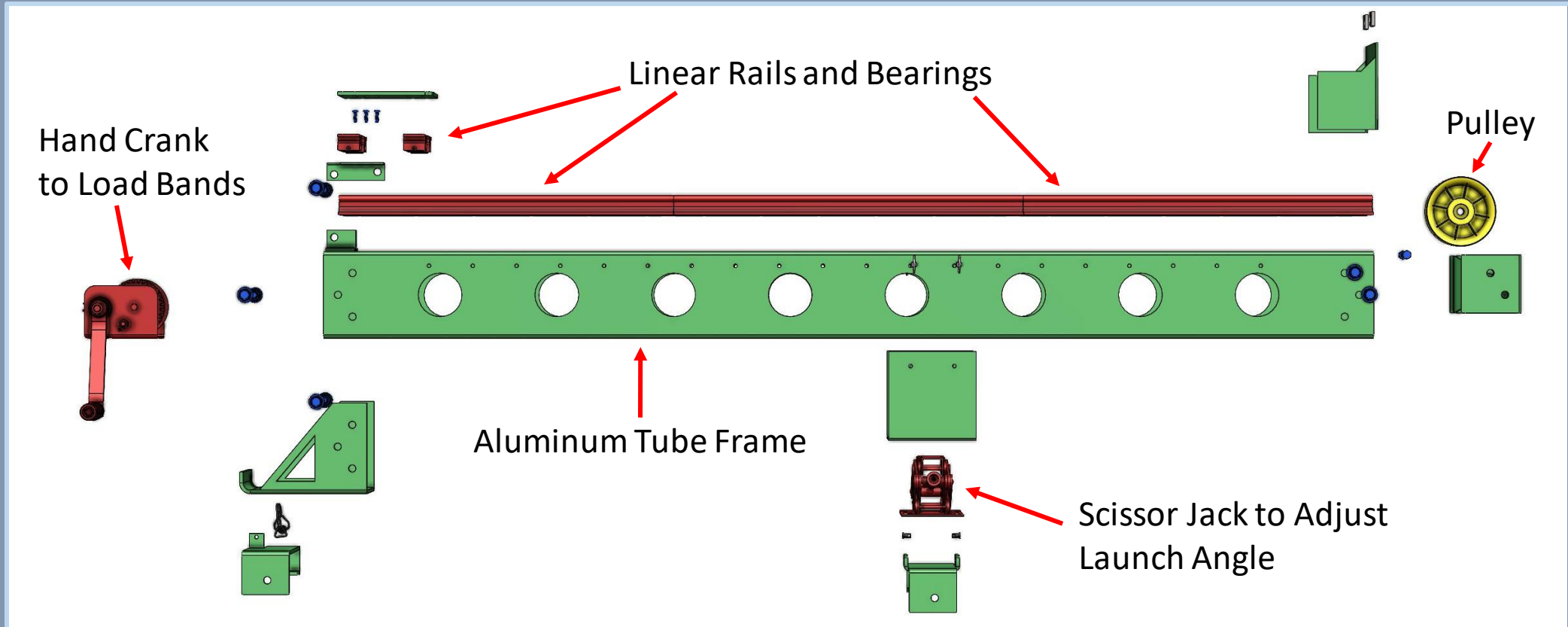
Side View of Launcher System

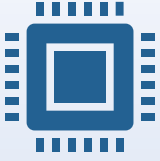




CAD Design

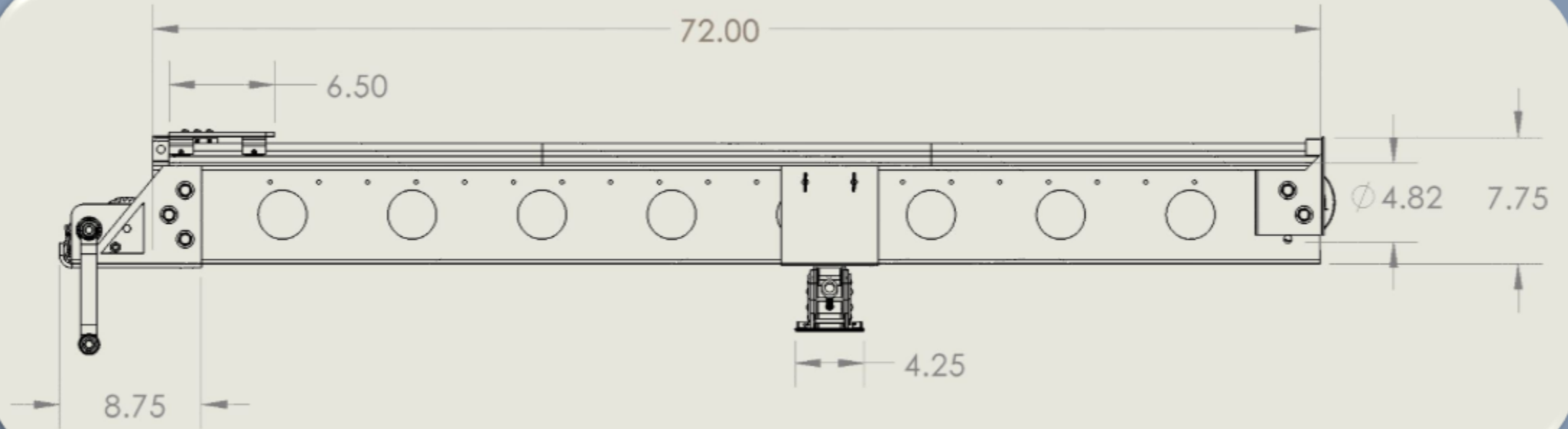
Exploded View of Launcher System





CAD Design

General Dimensions of Launcher





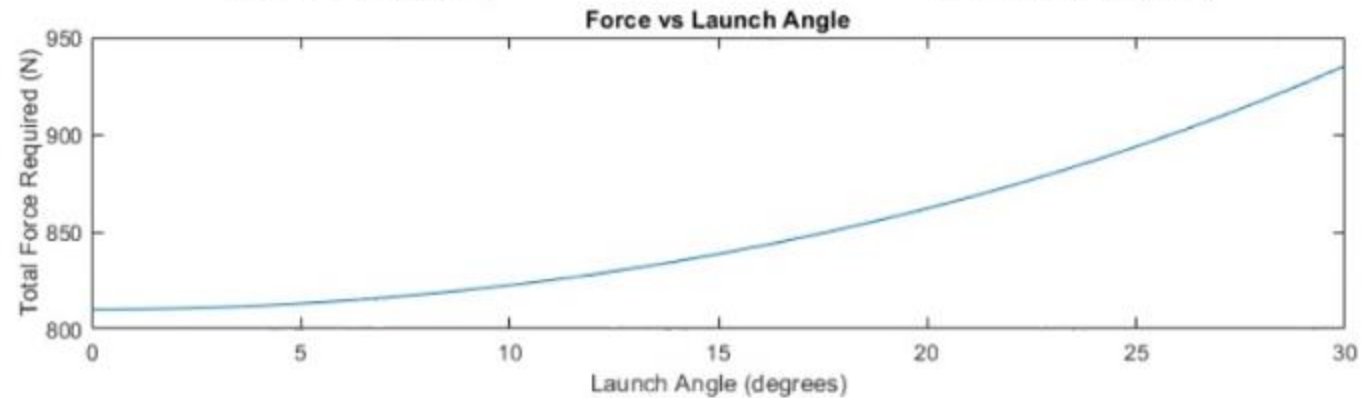
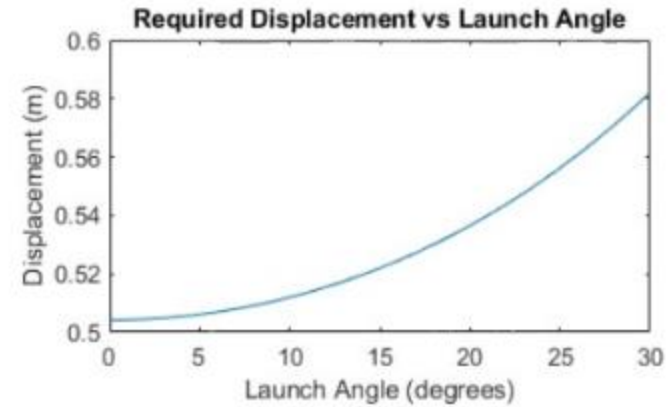
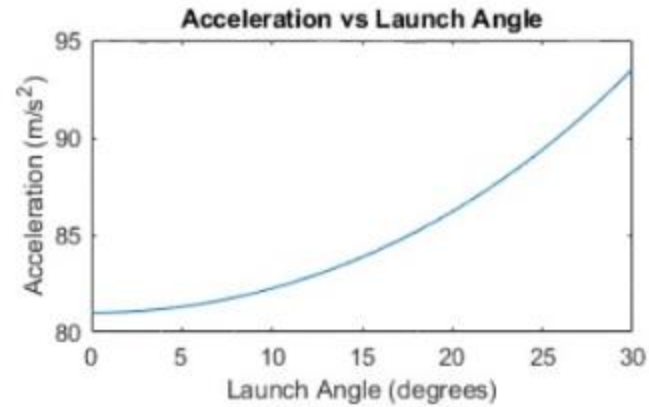
Calculations

Description	Calculated Values	units
Force for Launch	810 (182)	N (lbf)
Acceleration	81 (266)	m/s ² (ft/s ²)
Launch Velocity	18 (40)	m/s (mph)
Stress on Launcher	0.597 (86.6)	Mpa (psi)
Displacement of Band	0.504 (1.65)	M (ft)
Spring Constant of Band	803	N/m

Calculations were made for operation at a 0° Launch Angle



Calculations





Calculations

$$\text{acceleration} = \frac{V^2}{2 * dx}$$

$$F = k * dx$$

$$k = \frac{E * A}{\text{length of band}}$$

$$F = \text{mass} * \text{acceleration}$$

Mass used for calculations = 10kg or 22 lbs

Initial length of band = 0.325m or 1 ft



Materials Selection

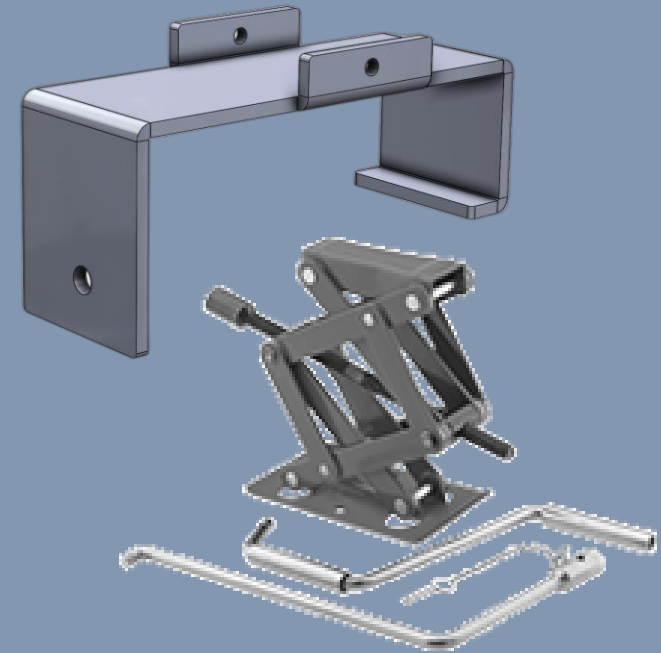
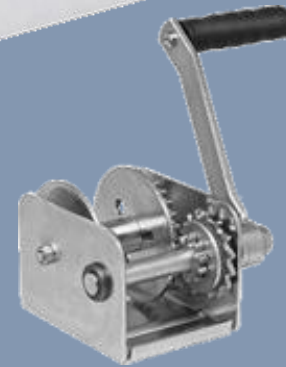
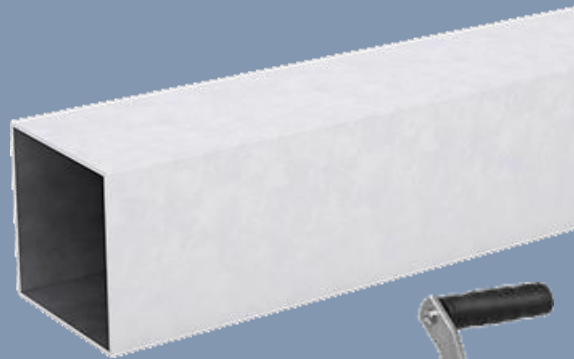
Metals:

6063-T5 Aluminum:

1. Main frame
2. Brackets

Carbon Steel:

3. Winch
4. Scissor Jack
5. Linear Rails

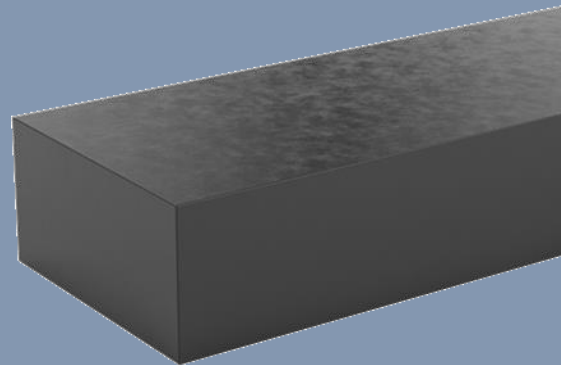




Materials Selection

Other Materials:

1. Low Stretch/High Strength Rope
2. Neoprene Rubber
3. Nylon Plastic



Mechanical Components

Name	Seller	Model #	Quantity	Cost
Pulley	McMaster Carr	59475K64	1	\$22.50
Hand Winch	McMaster Carr	3196T55	1	\$77.65
Linear Rails and Bearings	Amazon	SBR16	1 (Pack of Two)	\$79.99
Scissor Jack	McMaster Carr	2952T51	1	\$89.29

Hardware Components

Name	Seller	Model #	Quantity	Cost
Stainless Steel Bolts	McMaster Carr	97646A258	20	\$63.00
Stainless Steel M Bolts	McMaster Carr	LK-1440	1 (kit)	\$20.69
Wheel Axle	McMaster Carr	23595T15	1	\$3.20
Clevis Pin	McMaster Carr	98306A210	1 (Pack of 25)	\$10.69
Button Head Screw	McMaster Carr	98164A213	1 (Pack of 25)	\$10.10
Wire-Lock Clevis Pin	McMaster Carr	98480A009	1	\$7.65
Quick-Release Pin	McMaster Carr	95165A032	4	\$73.64

Materials and Launch Components

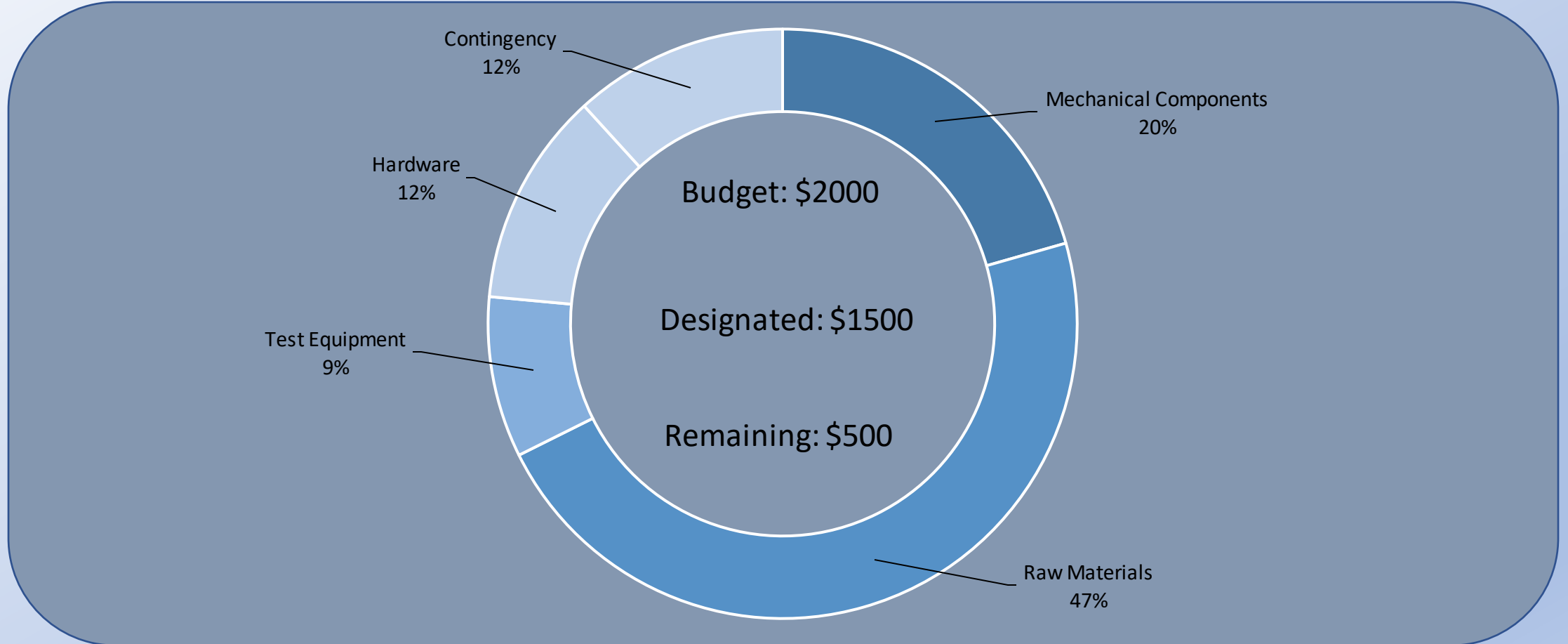
Name	Seller	Model #	Quantity	Cost
Aluminum Square Tube	McMaster Carr	88875K39	1 (6 feet)	\$220.23
Aluminum Sheet Metal	McMaster Carr	89015K88	1 (48" X 48" X .125")	\$384.47
High Strength/Low Stretch Rope	McMaster Carr	3852T43	25 feet	\$25.50
Elastic Bands	Amazon		10" X 5/8" OD	\$33.54
Speargun Band Rigging Kit	Amazon	SW-BANDKIT	1	\$59.95
Rubber Pad	McMaster Carr	1296N58	1 (1" X 2" X 36")	\$99.48

Testing Components

Name	Seller	Model #	Quantity	Cost
Drone			1	\$TBD (Optional)
Bushnell Velocity Speed Gun	Amazon	101911	1	\$119.00
Tensile Force Gauge	Amazon	ROMECH - 033	1	\$29.99

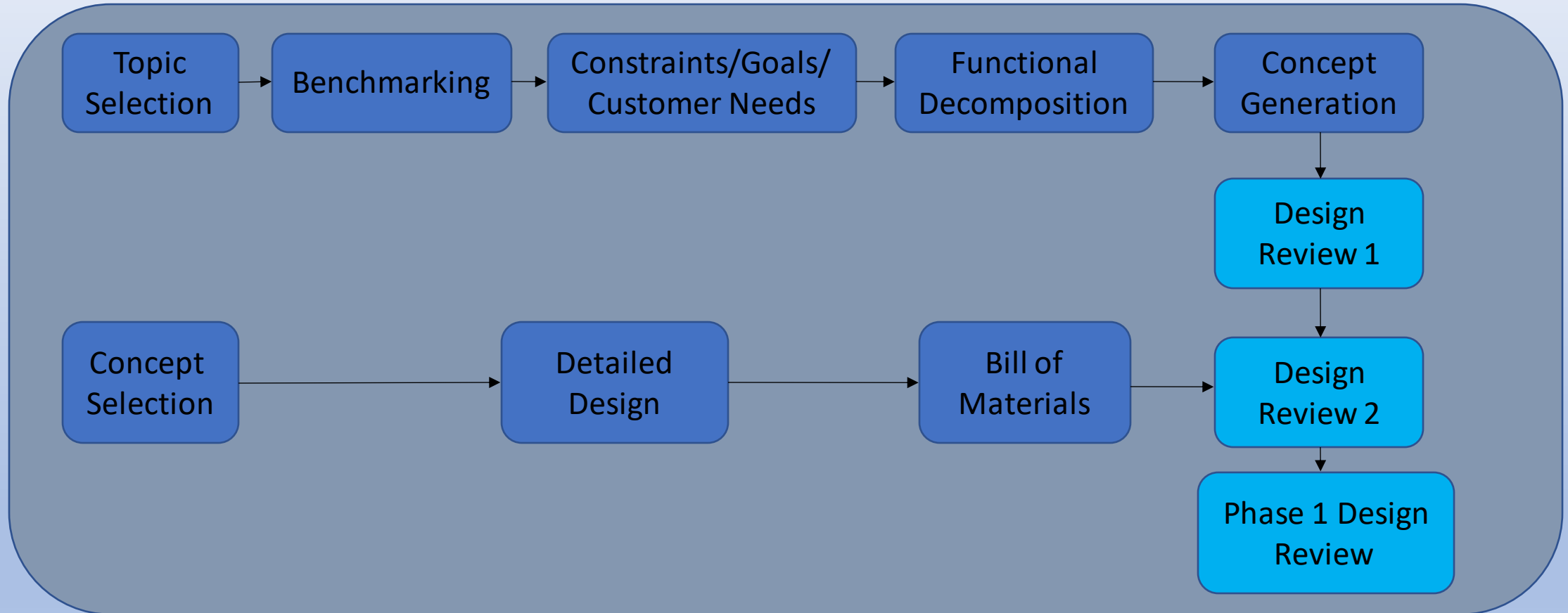


Budget Breakdown





Phase 1 Overview





Project Timeline Update



Questions?

[Check out our website!](#)

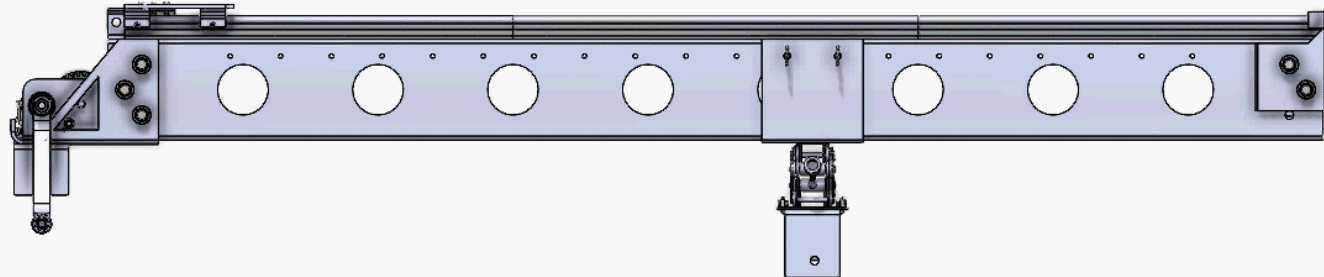
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