



Vision Quest

Seeking innovative solutions for a better world

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FINAL REPORT : AMPHIBIOUS BICYCLE KIT

Overview

- Research Overview and Problem Statement
- Concept Generation
- Product Design and Function
- Engineering Analysis and Design for Assembly
- Manufacturing and Materials
- Comparison to Benchmarks
- Economic Analysis

Research

■ Market Research

- VQDT found out that 96.8 million people are affected by floods annually. The poor and rural areas of cities are largely affected by this disaster.

■ Customer Research

- In addition to the cost and widespread affects, one of the biggest complications associated with flooding is lack of available transportation to safer locations in areas with no immediate aid.

■ Patent Research

- The existing paddle boat was very expensive. This would limit the market size as cost would become a factor.

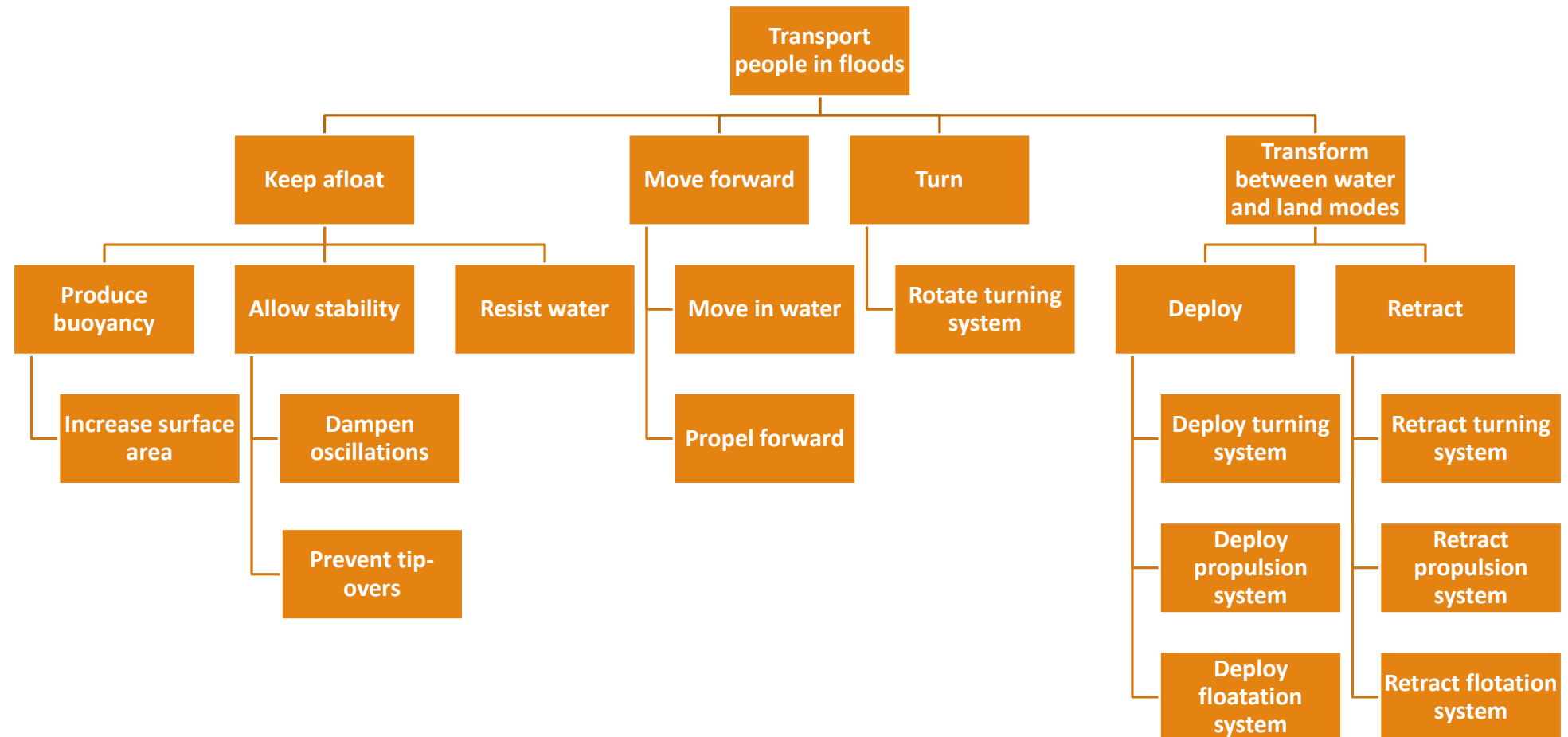
Problem Definition

- Updated problem definition
 - The transportation of people in post-flood situations using attachments to a bicycle. This is concentrated to people in rural and poor areas.
 - Creating a list of materials and manufacturing parts required in the Bill Of Materials, making CAD models for our attachments and analyzing an economic model of the design.

Results of Problem Definition

- Low cost
- Light Weight
- Easy to use
- Low maintenance
- Durable
- Takes less than five minutes to install
- Supports up to 115 kilograms
- Takes less than 60 seconds to deploy

Concept Generation (Chart 1: Function Tree)



Concept Generation

(Chart 2: Morphological Chart)

Functions	Possible Solutions				
<i>Turning</i>	Back Rudder	Front Rudder			
<i>Increase Surface Area</i>	Pontoon	Ripcord Floats	Stabilizers	Pool Noodle	
<i>Resist Water</i>	Silicone Spray	Zinc Powder Coat	Paint	PVC Parts	
<i>Propel Forward</i>	Fins in Spokes	Sail	Enclosed Propeller	Open Propeller	Paddle
<i>Maneuver Through Water</i>	Front Wedge				
<i>Deploy/Retract Floatation</i>	Ripcord	Zip Tie	Snaps	Hand Pump	Motor Pump
<i>Deploy/Retract Propulsion</i>	Slip Fins into Spokes	Fold Fins out of Spokes	Mount Propeller On Wheel		
<i>Prevent Tipping</i>	Wide Base	Square Pontoon Base	Triangle Pontoon Base	Ring of Pool Noodles	

Final Concept

Final Concept:

- Front Rudder
- Clamp
- Inflatable Pontoon
- T – Base
- Pump
- Front Wedge

Primary Concept:

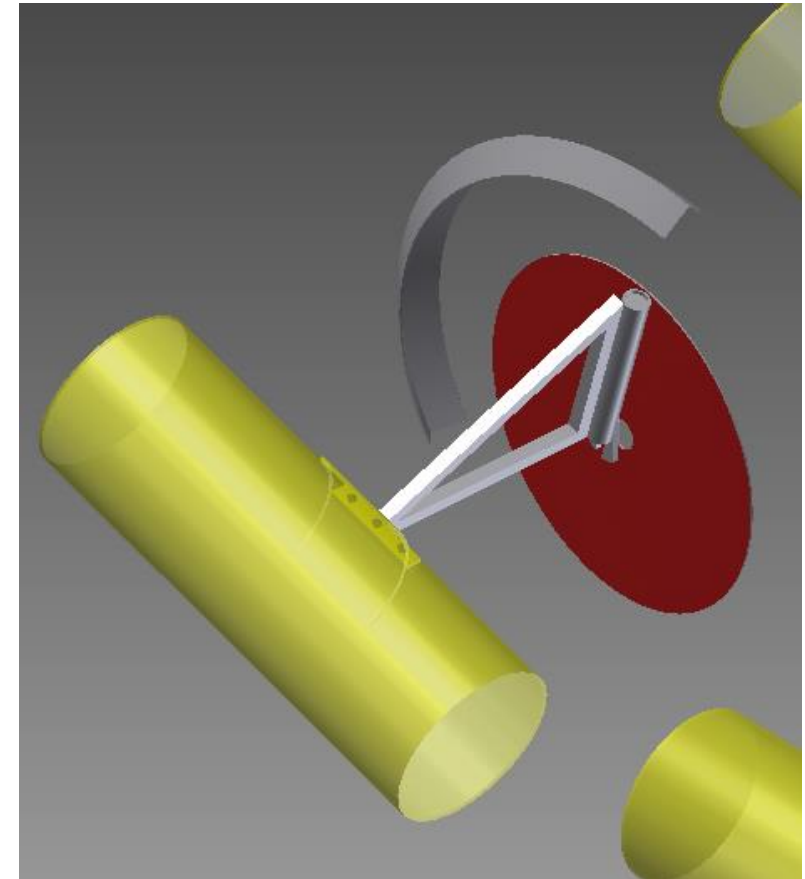
- Front Rudder
- Paint
- Snaps
- Rip Cord
- Triangle Base
- Fold Fins
- Front Wedge

Datum Concept

- Front Rudder
- Paint
- Clamps
- Inflatable Pontoon
- Square Base
- Propeller

The Design: Front Unit

- Connects to bicycle on front axle and on steering column
- Has support for pontoons
- Comes to point at front, acting as wedge
- Disk is inserted into front tire
- Unit rotates as steering column is rotated, acting as a rudder



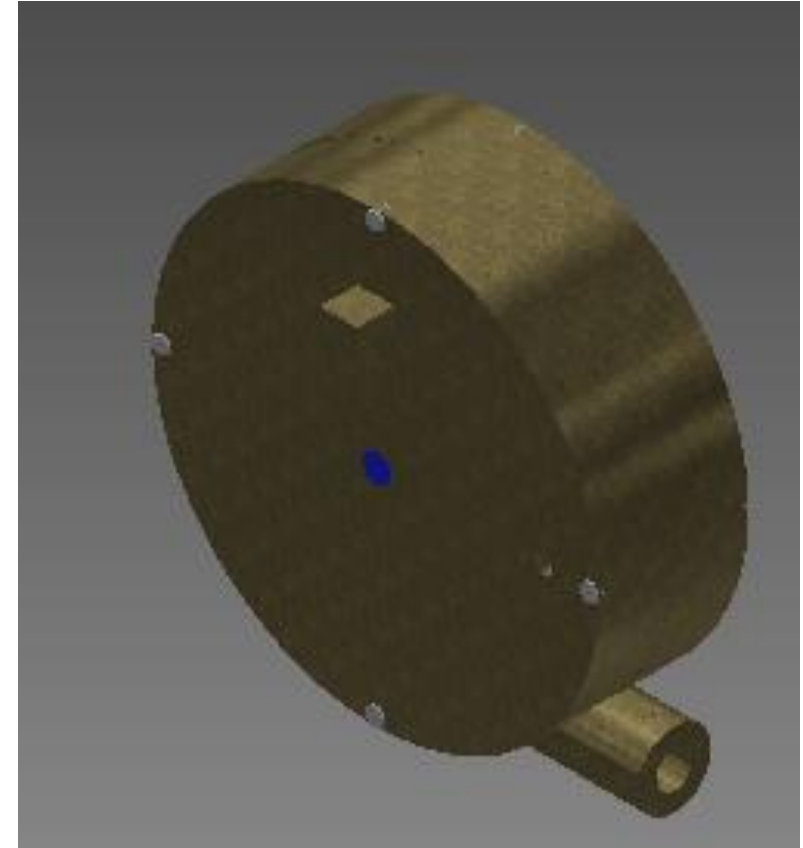
The Design: Rear Unit

- Attaches to bicycle on rear axle and seat post
- Has support for pontoons



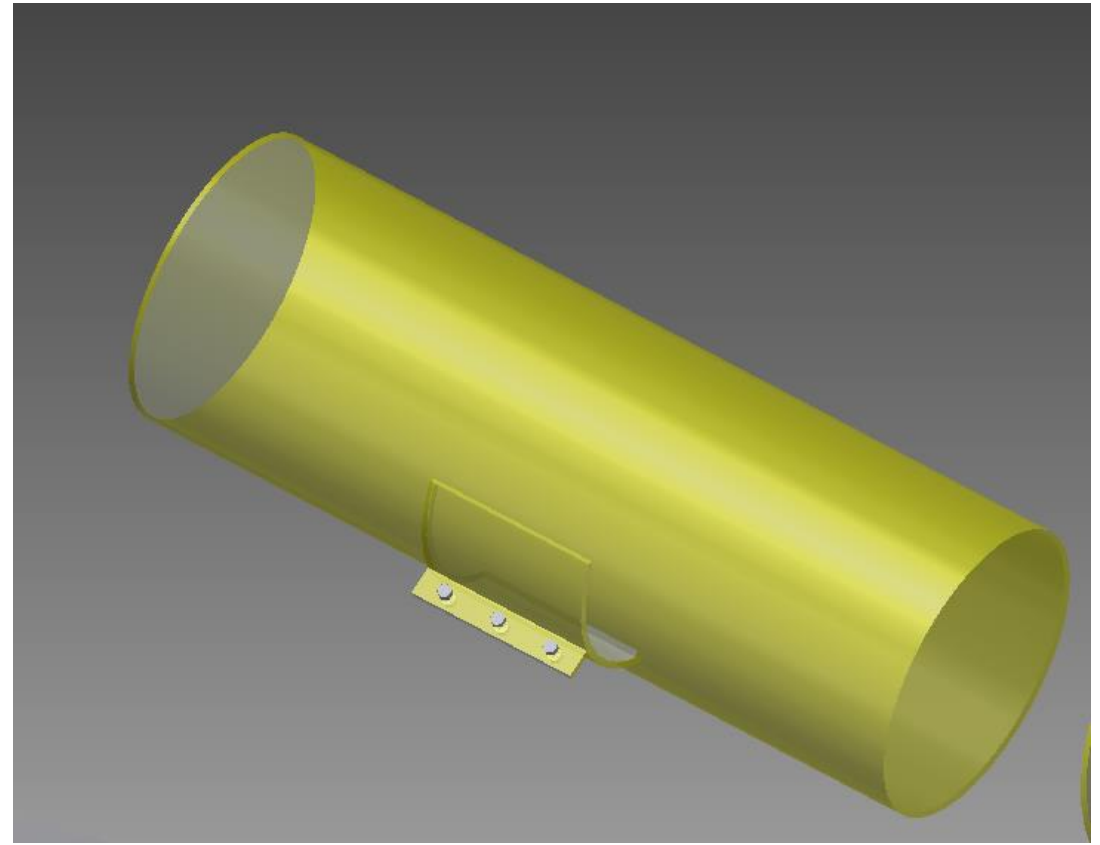
The Design: Centrifugal Pump

- Rotates as pedals are rotated
- Additional gear is mounted to chain to drive a second axle
- This axle drives another chain which drives the pump
- Forced rotation of fins inside of pump accelerates internal water velocity
- Water exits pump at maximum speed, forcing bicycle in opposite direction



The Design: Pontoons

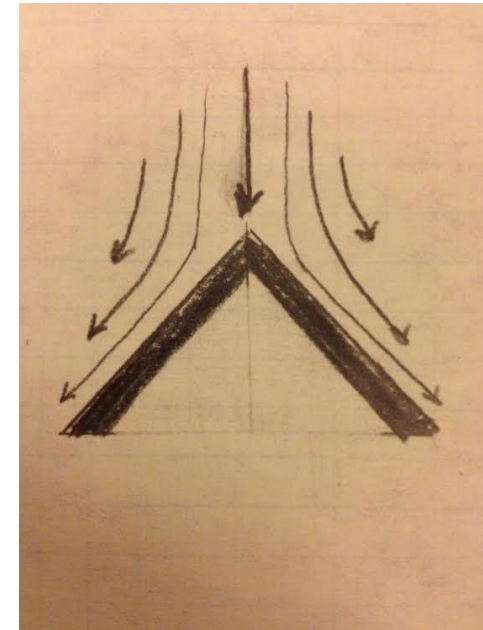
- Flexible PVC inflatable tubes
- Have standard valve stems for use with bicycle tire pumps



Concept: Front Wedge

- Function
 - Moving debris from path
- How it works
 - Forms wedge to cut through water
- Model Findings
 - Can be helpful in steering
 - Must be made of thin metal

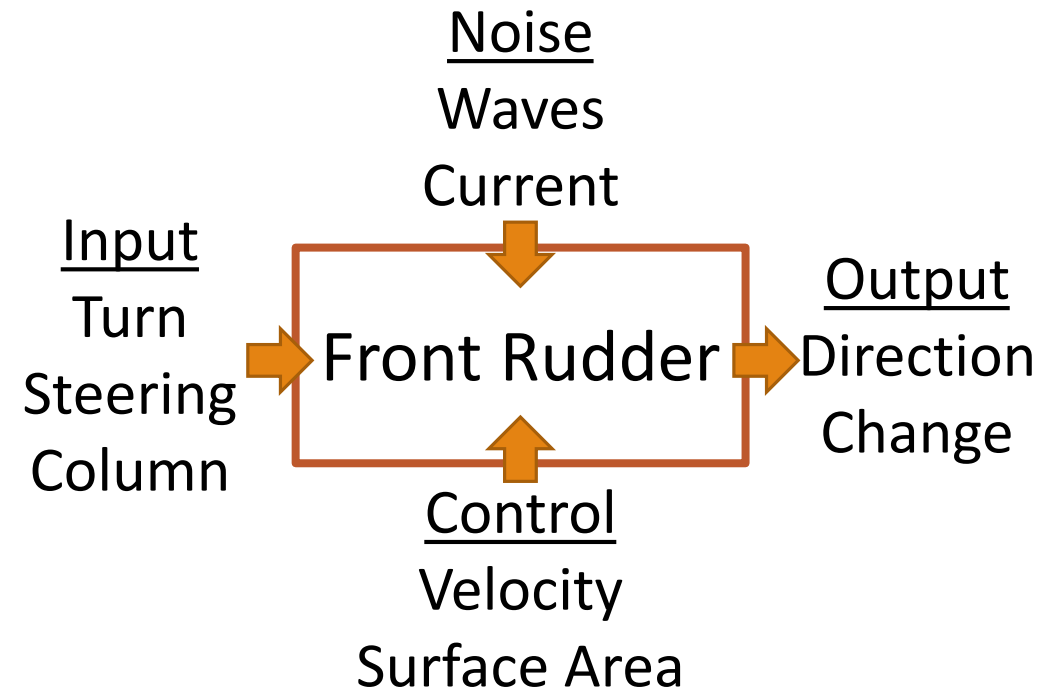
Diagram: Laminar Flow



Concept: Front Rudder

- Function
 - To allow the bicycle to turn
- How it works
 - Using the surface area created
- Model Findings
 - Consider using hollow rudder
 - Rudder adds 3.2kg of mass

P-Diagram: Front Rudder



Concept: Centrifugal Pump

■ Function

- Enclosed fin system
- Water cycles within case and forced out one outlet.

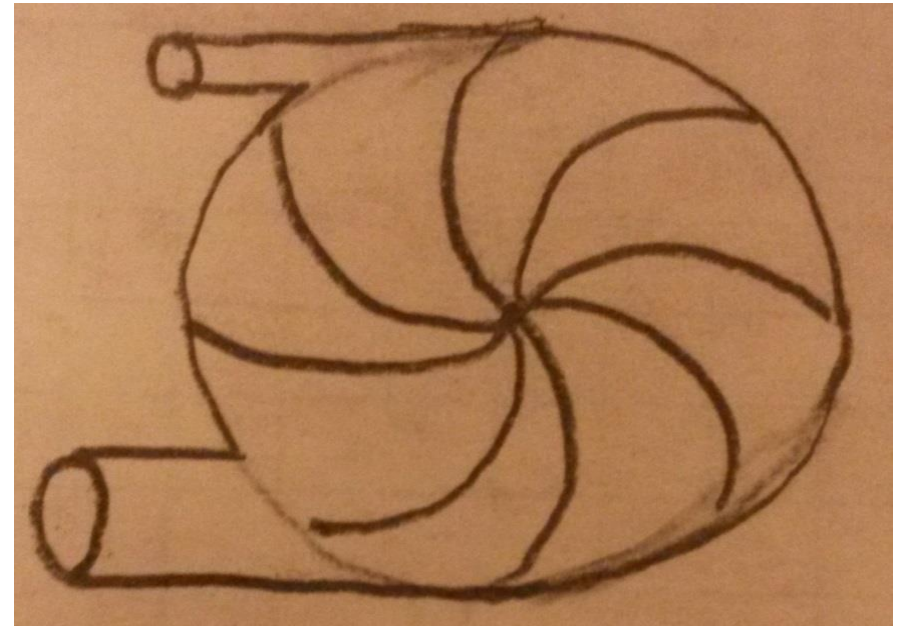
■ How

- Fins are attached to rear wheel
- Pressure from fins and case's cylindrical shape causes water to flow in circle
- Water is released at one outlet for maximum speed

■ Model Findings

- Most energy is conserved in this method for weight purposes

Diagram: Centrifugal Pump



Concept: Flotation Device

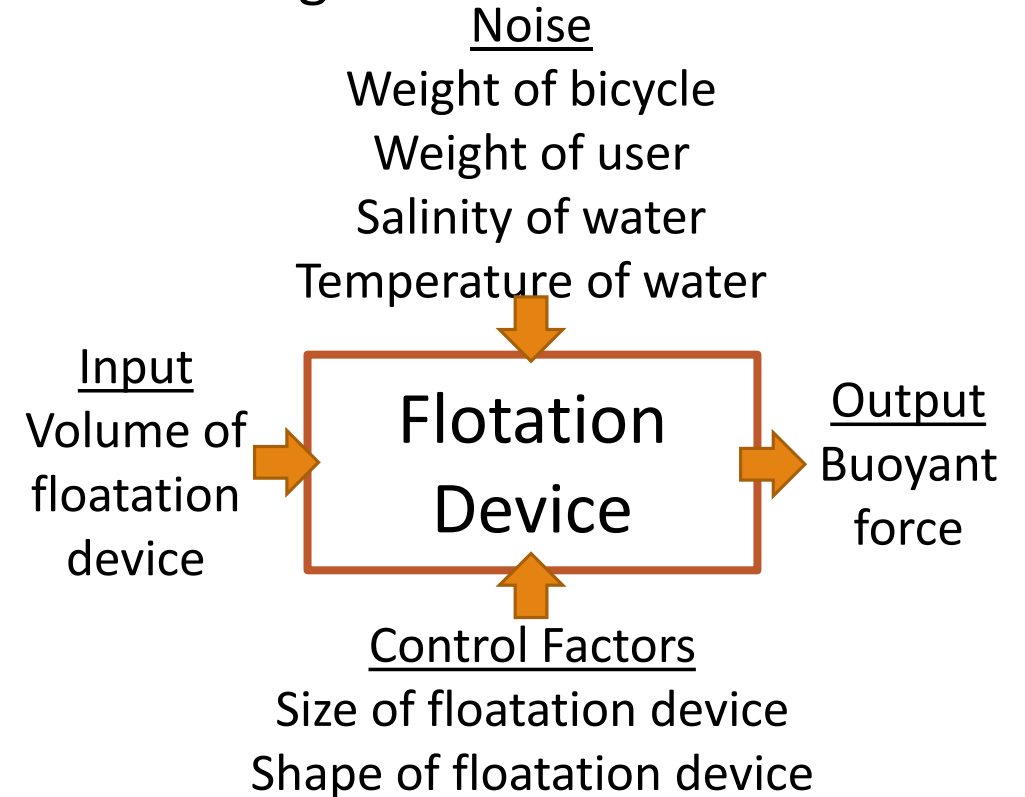
■ Function

- To provide a buoyant force for the whole device

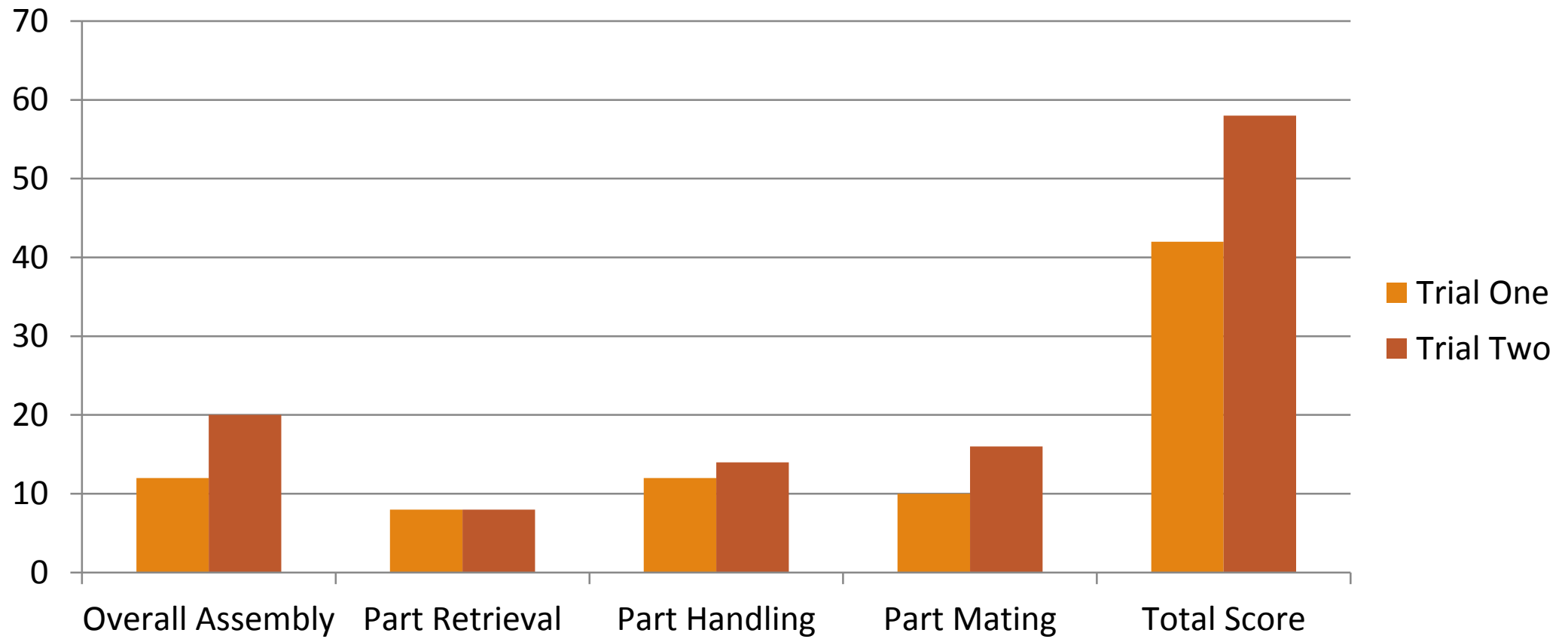
■ How

- Airtight compartment fills with air to provide buoyant force while in water

P-Diagram: Flotation Device



Design for Assembly



Materials

Aluminum 6061

- Pipes and Front Wedge
 - Corrosion Resistant
 - Easy to manufacture with (bend)
 - Light Weight
 - Lower Cost

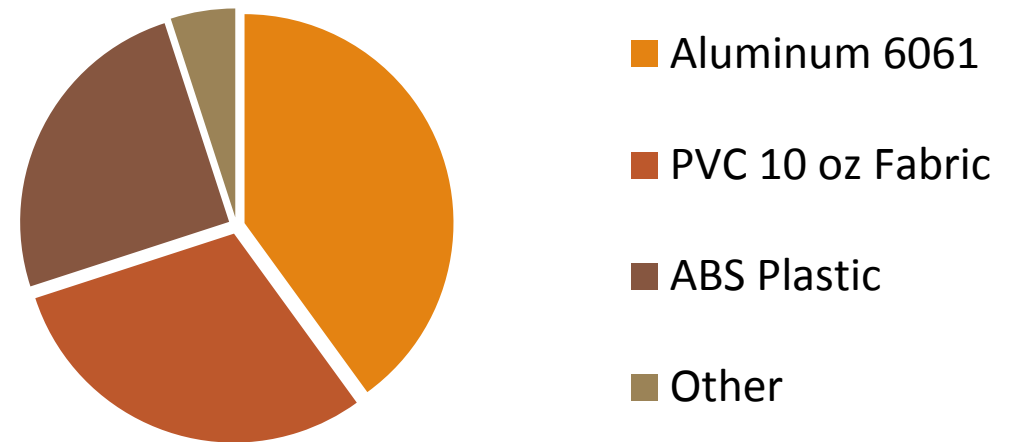
PVC 10 oz. Fabric

- Pontoons
 - Water Resistant
 - Tear and Puncture Resistant
 - Similar material used on inflatable life rafts

ABS plastic

- Pump
 - Easy to manufacture with
 - Water Resistant

Chart 3: Use of Material by Mass



Manufacturing

Pontoons

Cut Fabric

Sew Fabric

Front Wedge

Bend Sheet Metal

Drill Holes for Mounting

Mounts

Cut Pipes to Length

Bend Pipes

Weld on Axle Mounts

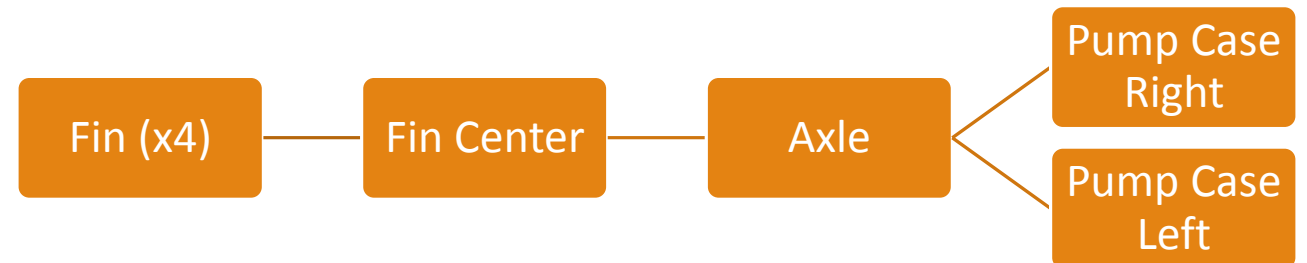
Drill Holes and Chamfer

Pump

CNC Mill pump case and fins

**only assembly is the pump and case*

Chart 4: Pump Assembly Flow Diagram



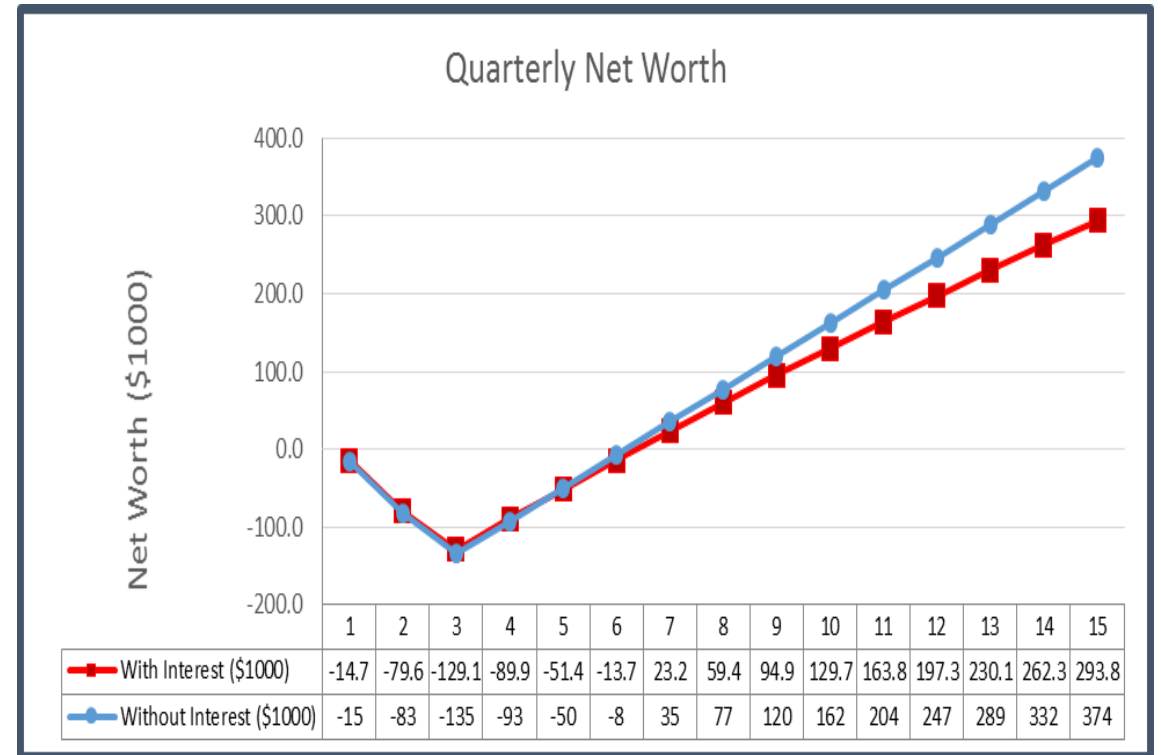
Comparison to Benchmarks

- The Shuttle Bike is the only comparable product on the market
- Costs \$5000
- Can be stored in backpack
- Takes 15 minutes to deploy
- Not amphibious



Economic Analysis

- Pay Back Period: 7th Quarter
- Net Present Value: \$294k
- Min production: 1061
- Return on Investment: 74%



Questions

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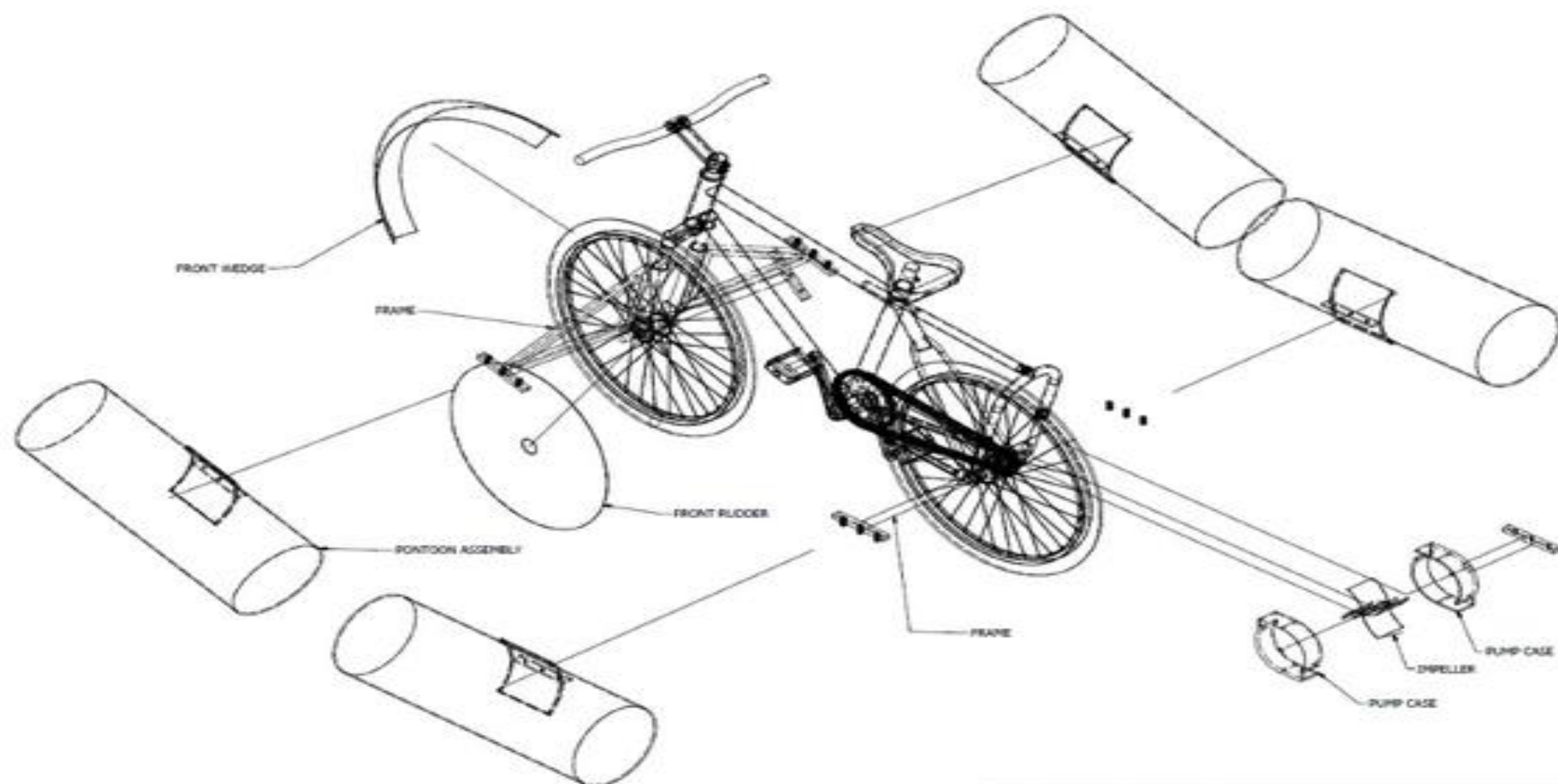
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References

- [1] Eric Guyer (2011). *Expert Witness Painting Aluminum – Paint Failure and Defects*. Retrieved from <http://www.the-coatings-expert.com/painting-aluminum.htm>
- [2] SBK-KIT (2014). *Shuttle Bike*. Retrieved from <http://www.shuttlebike.it/index.html>



DESIGN	4/15/2014	Vision Quest Design Team	
APPROVED			
MAIN	4/30/2014		
QA			
FIN		Final Assembly Explosion	
EXPLORE	4/30/2014		
APPROVED			
REVIEW	4/30/2014		
PART NUMBER	PA	CODE	00
		FINAL ASSEMBLY	00