

Human Powered Vehicle Concept Generation and Selection

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Overview

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- Overall Vehicle Design
- Concept Generation and Selection
 - Frame
 - Steering
 - Drivetrain
 - Ergonomics
 - Fairing
 - Innovation
- Gantt Chart
- Conclusions
- References

Project Description

- “Design a human powered vehicle that can function as an alternative form of transportation.”
- Objectives
 - High Speed
 - Aerodynamic Drag
 - Maneuverable
- ASME Human Powered Vehicle Challenge
- Clients – Perry Wood & ASME

Overall Vehicle Design

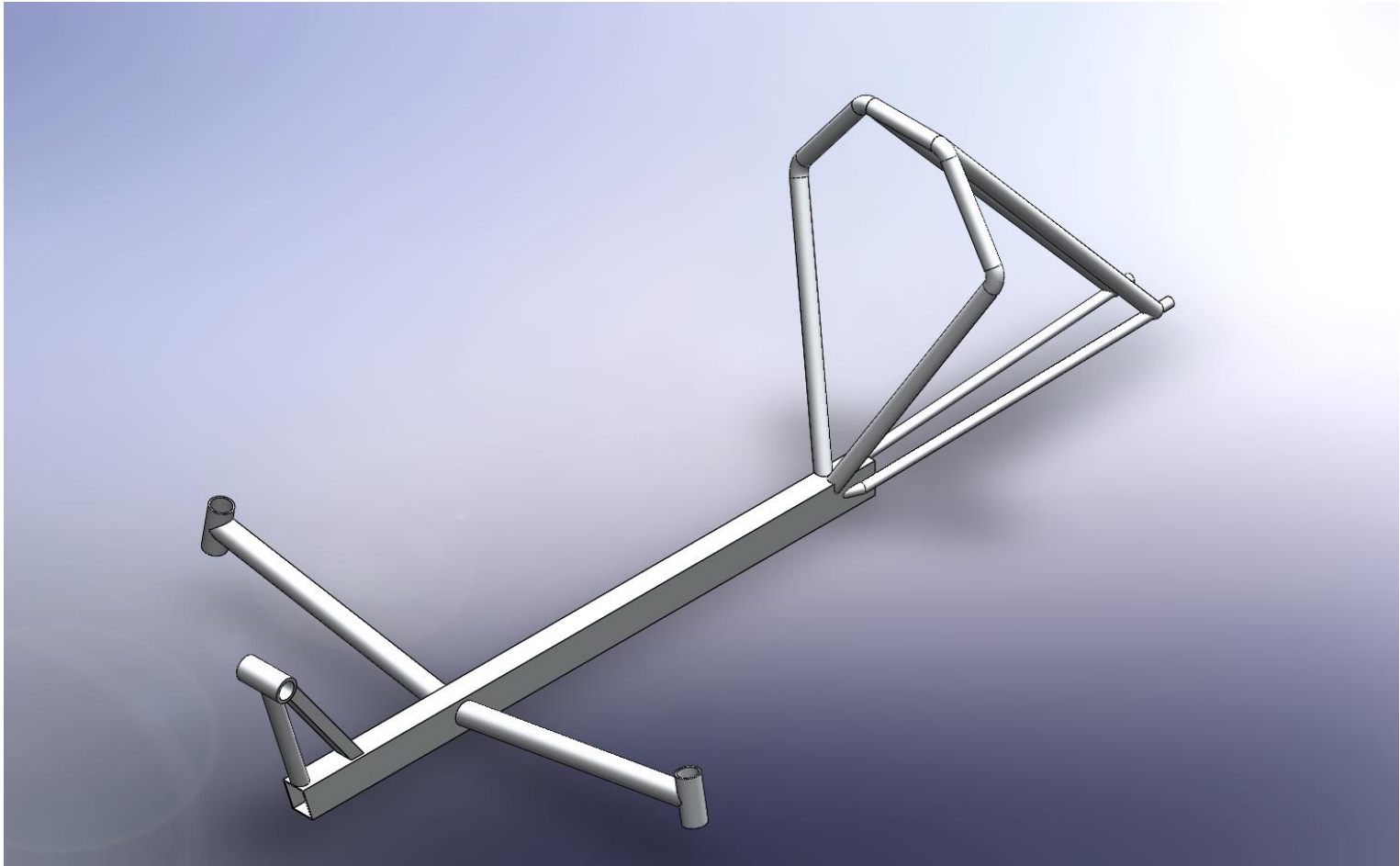
Vehicle Configuration

	Score Factor	Recumbent Bicycle	4 Wheeled	Delta Trike	Tadpole Trike	Airplane	Multiple Rider Land Vehicle
Low Speed stability	0.107	2	6	4	5	1	3
Stop & Go Traffic	0.214	2	6	4	5	1	3
Top Speed	0.143	6	3	4	5	1	2
Cargo Capability	0.071	3	6	4	5	1	2
Vehicle Weight/Rider	0.107	6	2	5	5	3	4
Efficiency	0.250	6	2	4	5	1	3
Maintenance	0.036	6	3	5	5	1	4
Durability	0.071	2	6	5	5	1	4
Scores	1.00	4.21	4.04	4.21	5.00	1.21	3.00

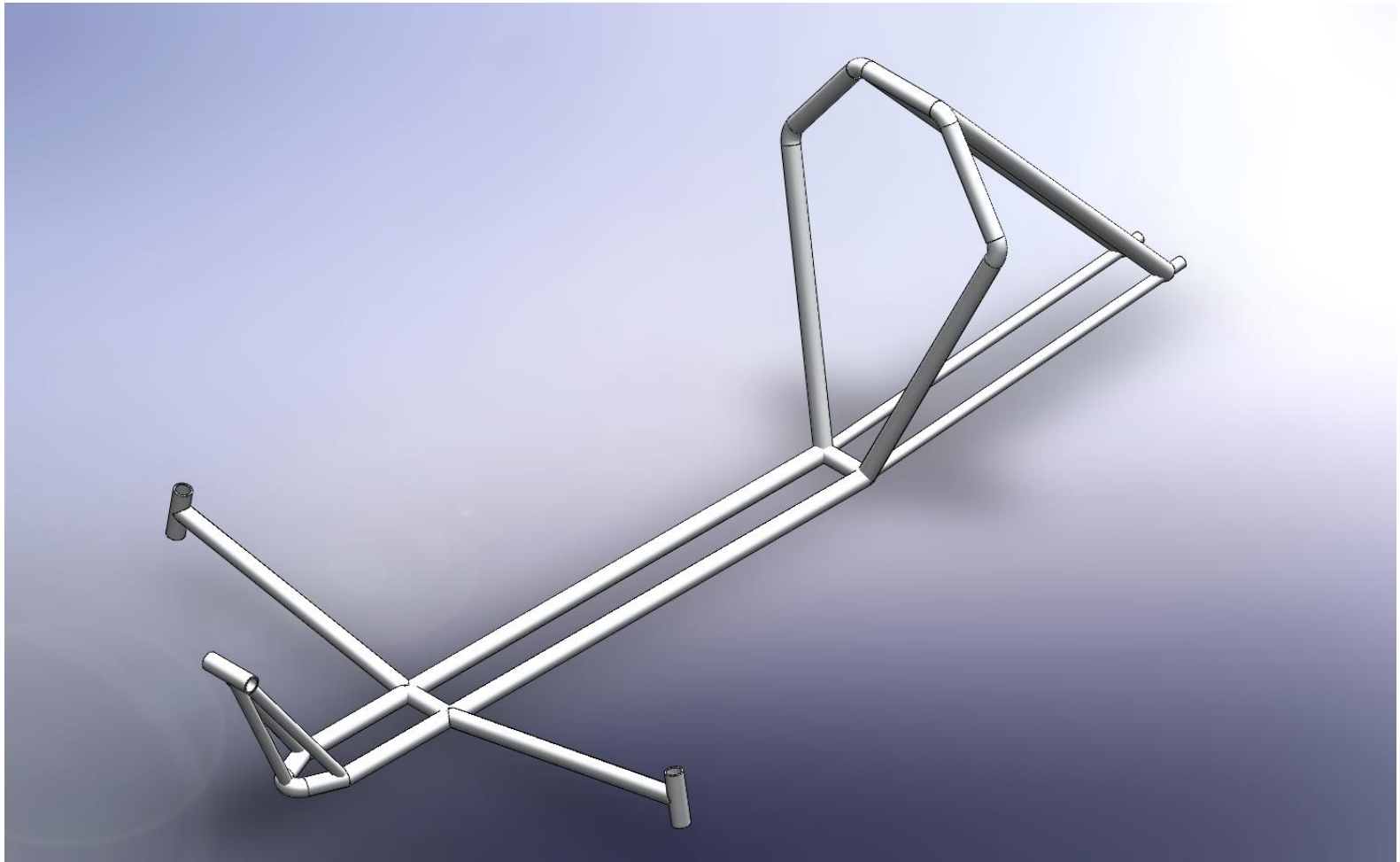
Concept Generation: Frame

- Design Concepts
 - Rectangular
 - Double Circular
 - Circular

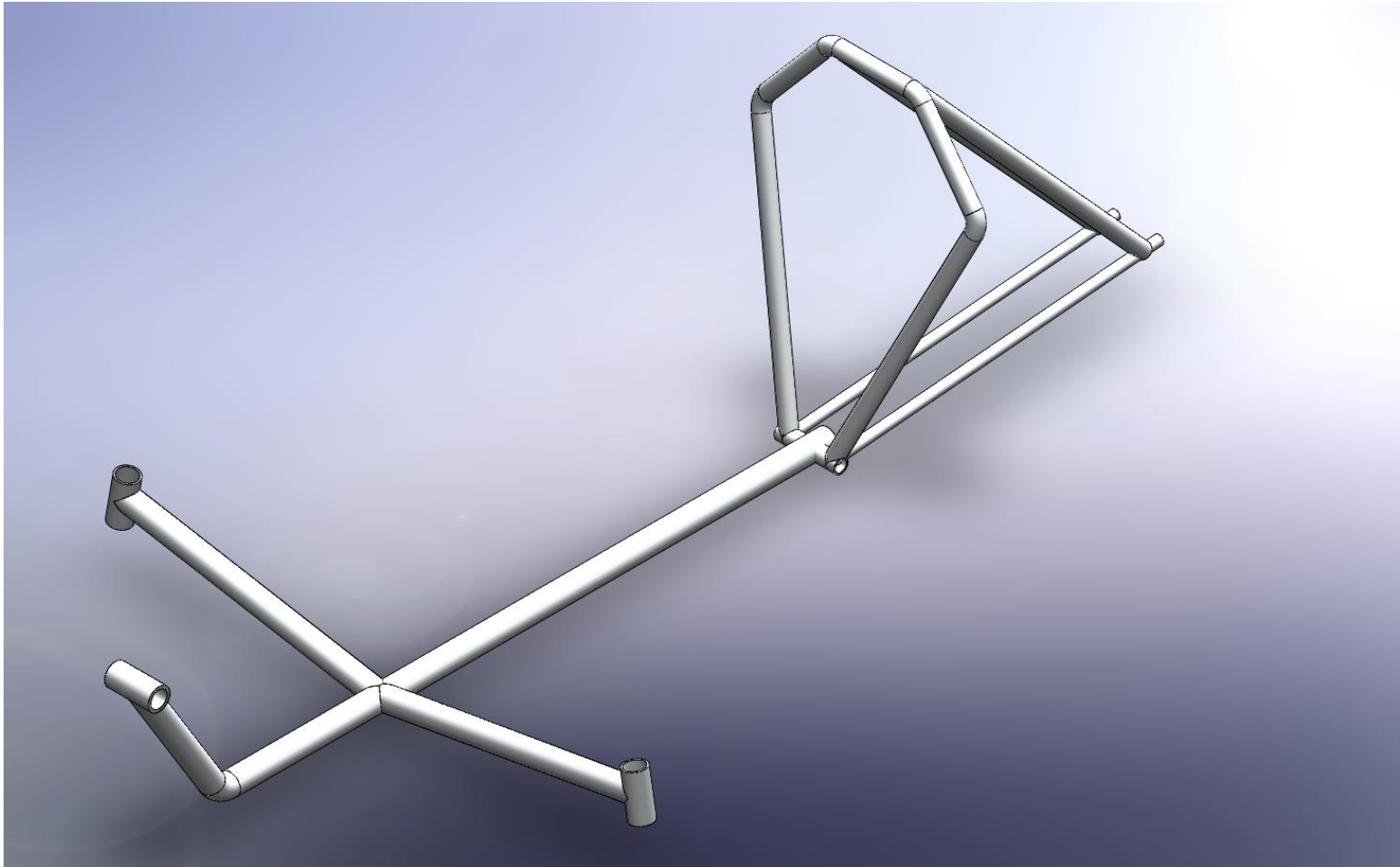
Rectangular



Double Circular



Circular



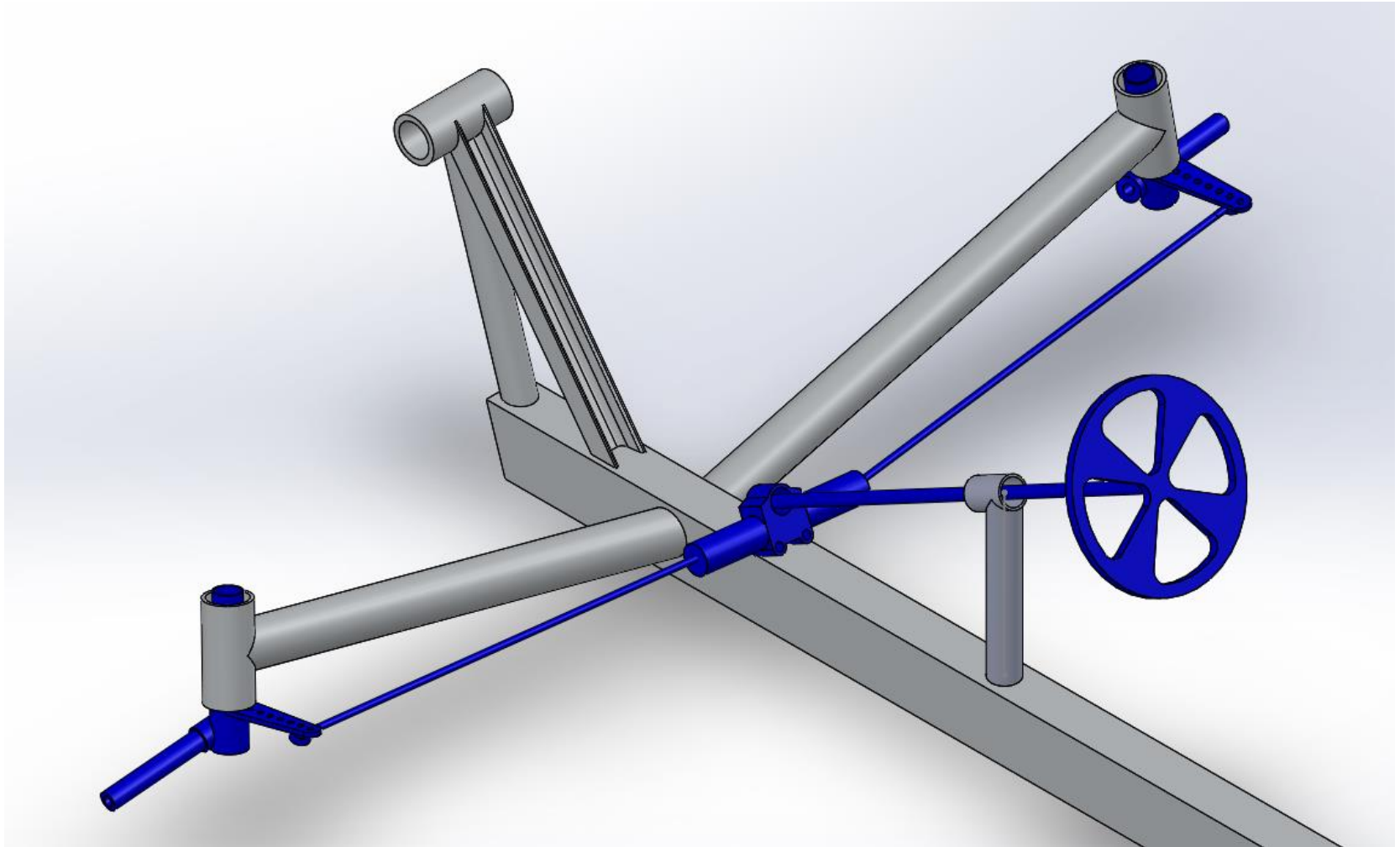
Concept Selection: Frame

	WEIGHT	EASE OF SEAT INTEGRATION	RESISTANCE TO DEFLECTION	FABRICATION TIME	
Weight	1/5	1/5	2/5	1/5	
CIRCULAR	3	1	1	2	Score
Weighted score	3/5	1/5	2/5	2/5	1.6
RECTANGULAR	2	3	3	3	
Weighted score	2/5	3/5	1 1/5	3/5	2.8
DOUBLE CIRCULAR	1	2	2	1	
Weighted score	1/5	2/5	4/5	1/5	1.6

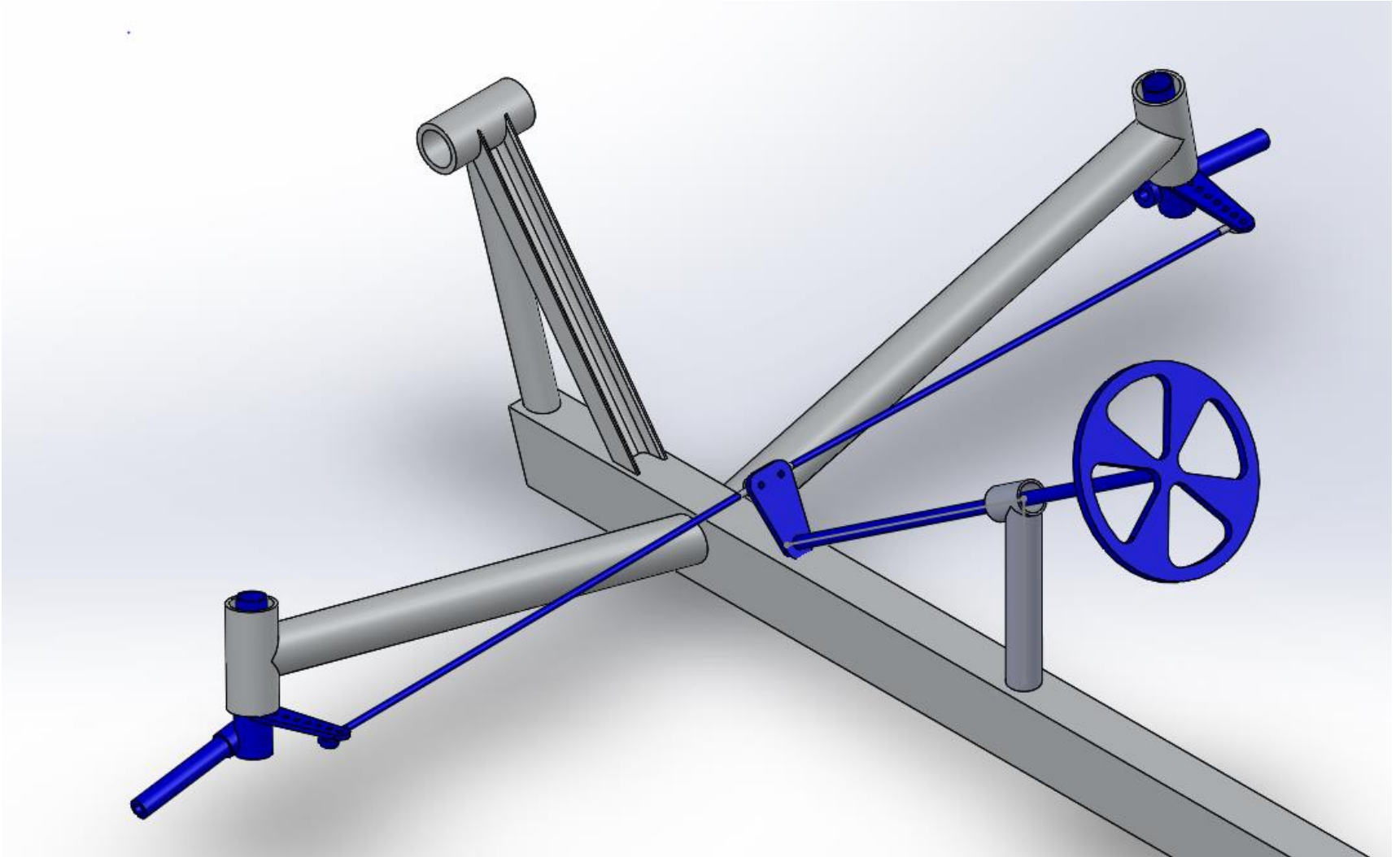
Concept Generation: Steering

- Design Concepts
 - Rack and Pinion
 - Pittman Arm
 - Bell Crank Push Pull

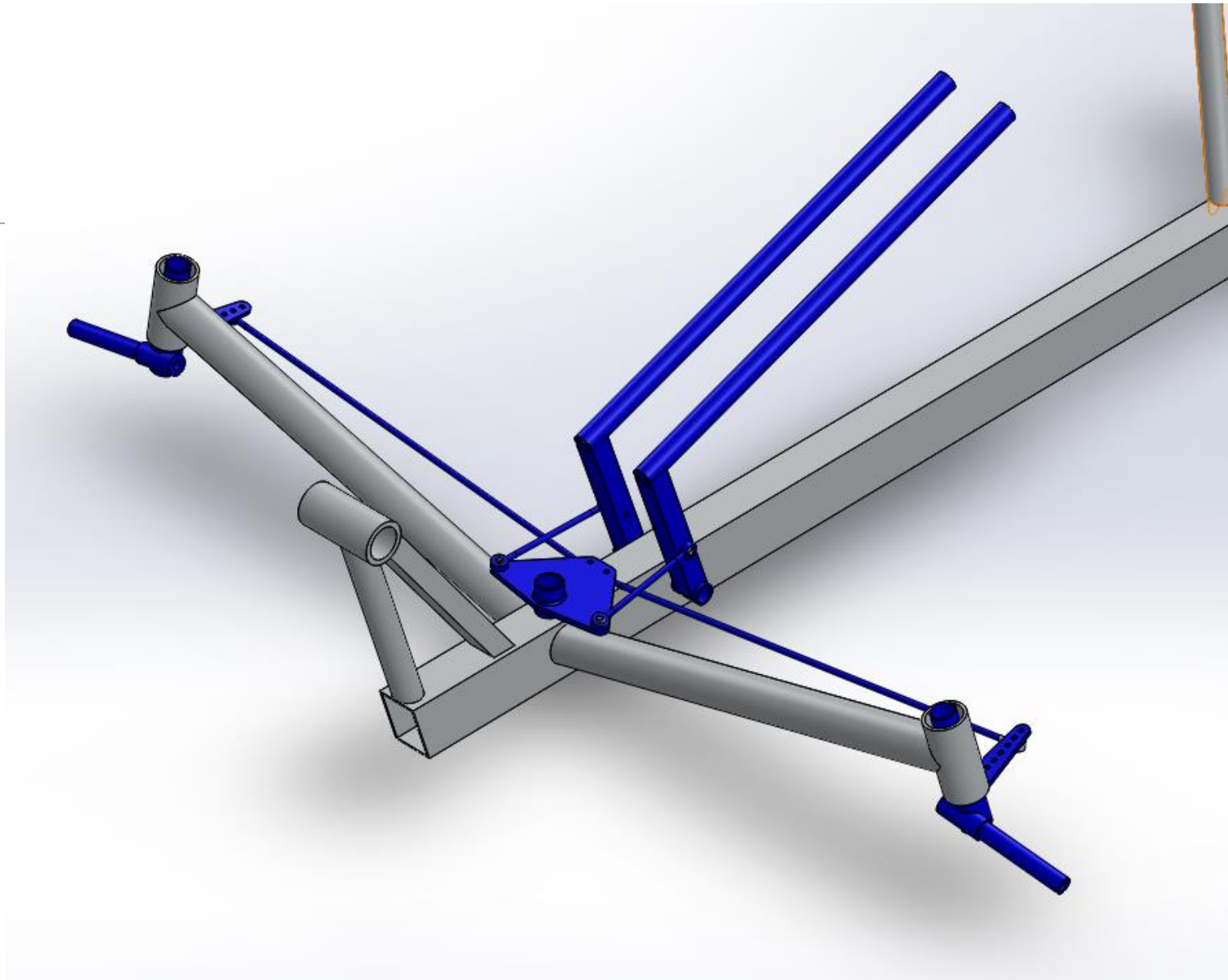
Rack and Pinion



Pittman Arm



Bell Crank Push Pull



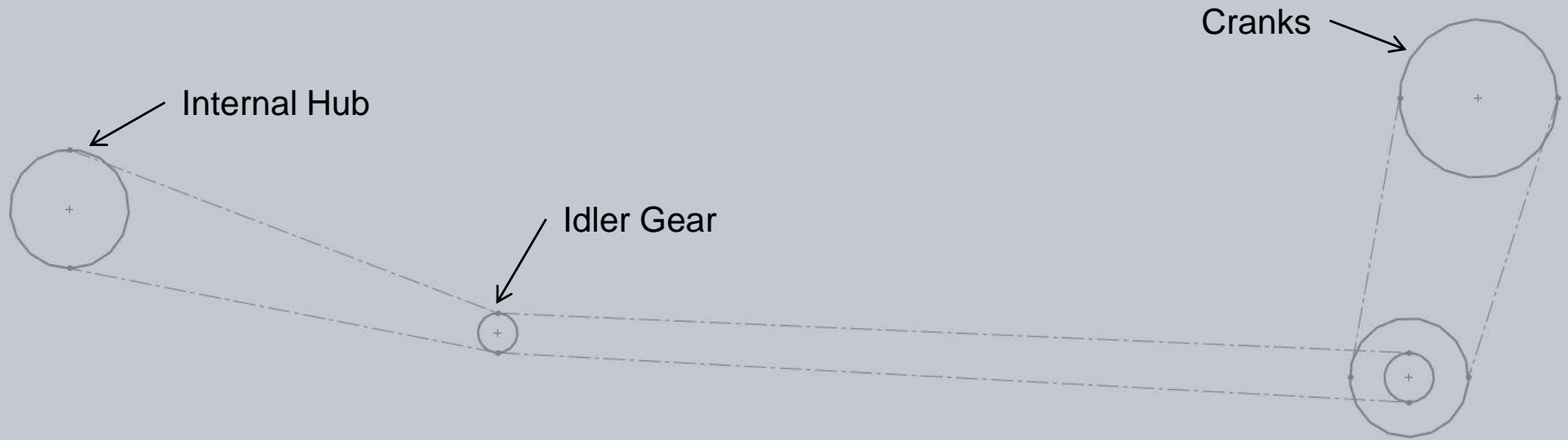
Concept Selection: Steering

	Weight	Cost	Ease Of Use	Ease Of Exiting Vehicle	Fabrication Time	Adjustability	Play	
RACK & PINION	2	2	4	2	9	3	4	SCORE
WEIGHTED SCORE	21/58	1/5	77/94	13/35	12/35	16/35	21/38	3.1048
PITMAN ARM	8	3	3	2	7	3	8	
WEIGHTED SCORE	1 17/38	3/10	43/70	13/35	4/15	16/35	1 2/19	4.5619
BELL CRANK PUSH PULL	6	8	7	8	3	6	3	
WEIGHTED SCORE	1 3/35	4/5	1 13/30	1 17/35	4/35	32/35	29/70	6.2476

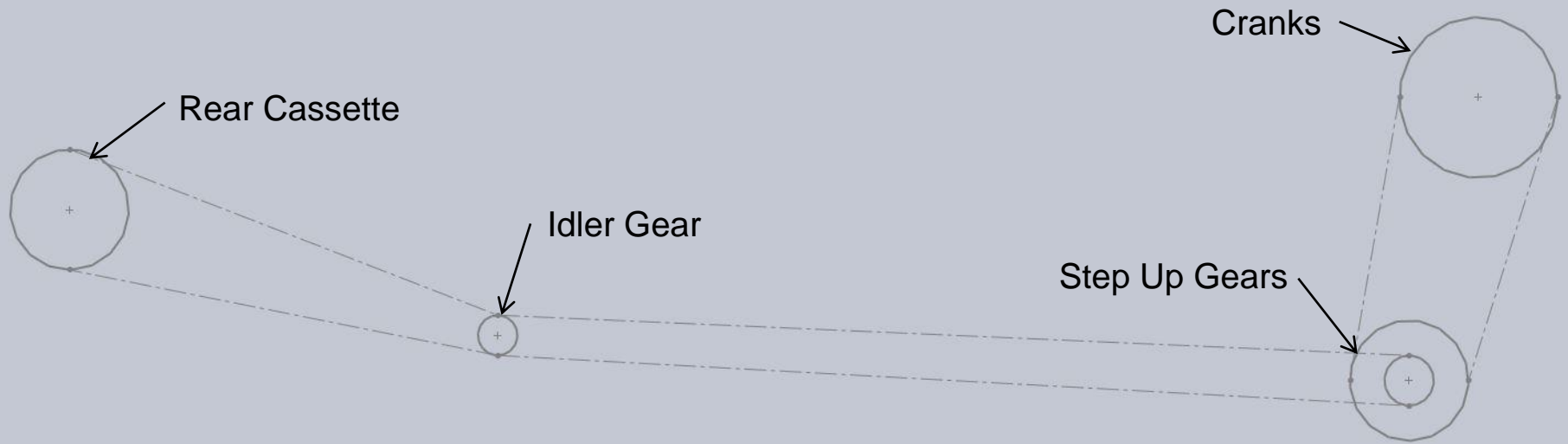
Concept Generation: Drivetrain

- Design Concepts
 - Internally geared hub
 - Step up gear
 - Step up gear with reverse

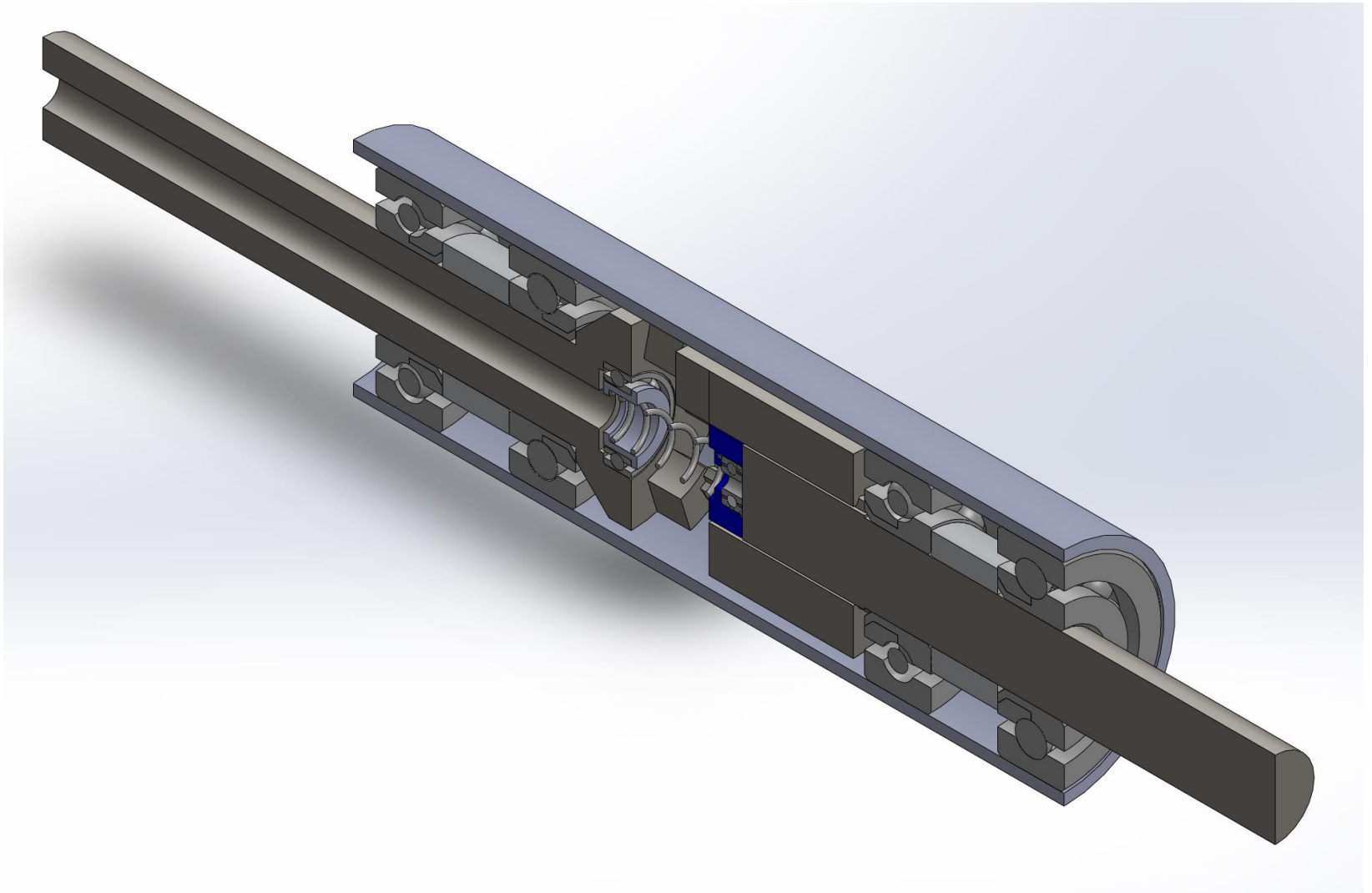
Internally Geared Hub



Step Up Gear



Reverse Gear



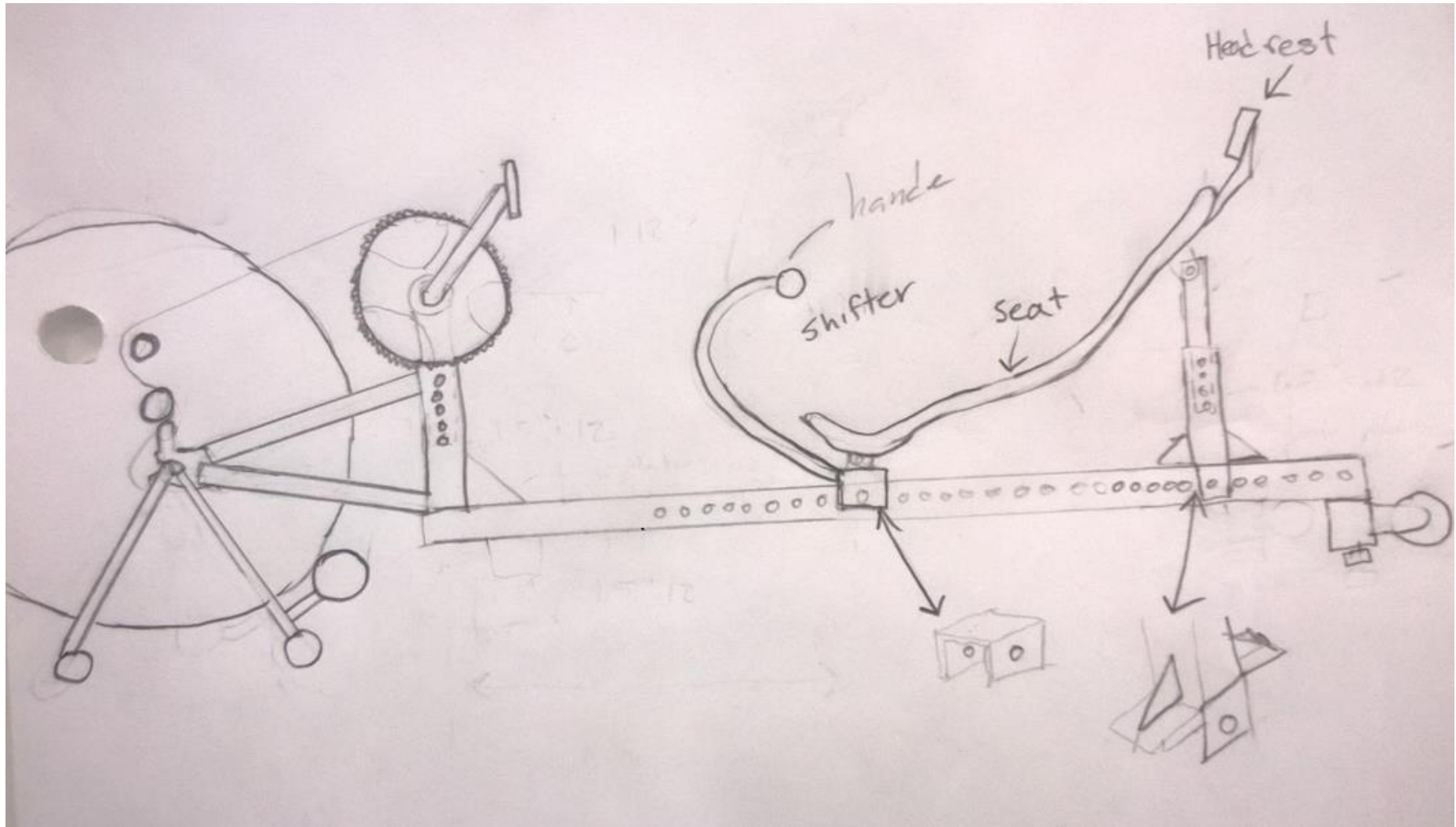
Concept Selection: Drivetrain

- Step Up Gear With Reverse Gear
 - Advantages
 - Large gear range
 - Efficiency
 - Ability to go in reverse

Ergonomics

- Rider Position
- Test using trainer
 - Angles
 - Maximum Power Output

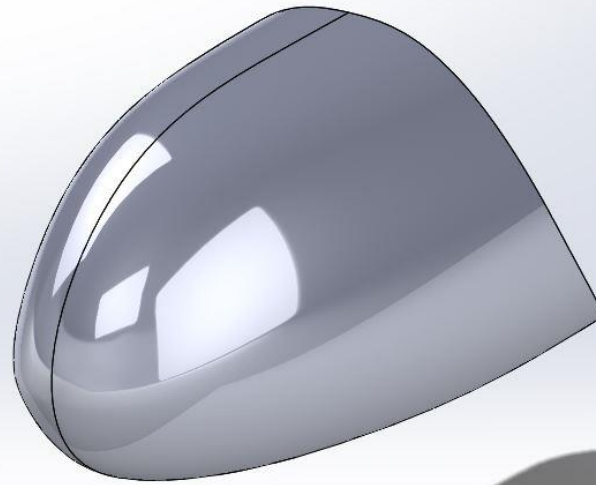
Rider Position Test Fixture



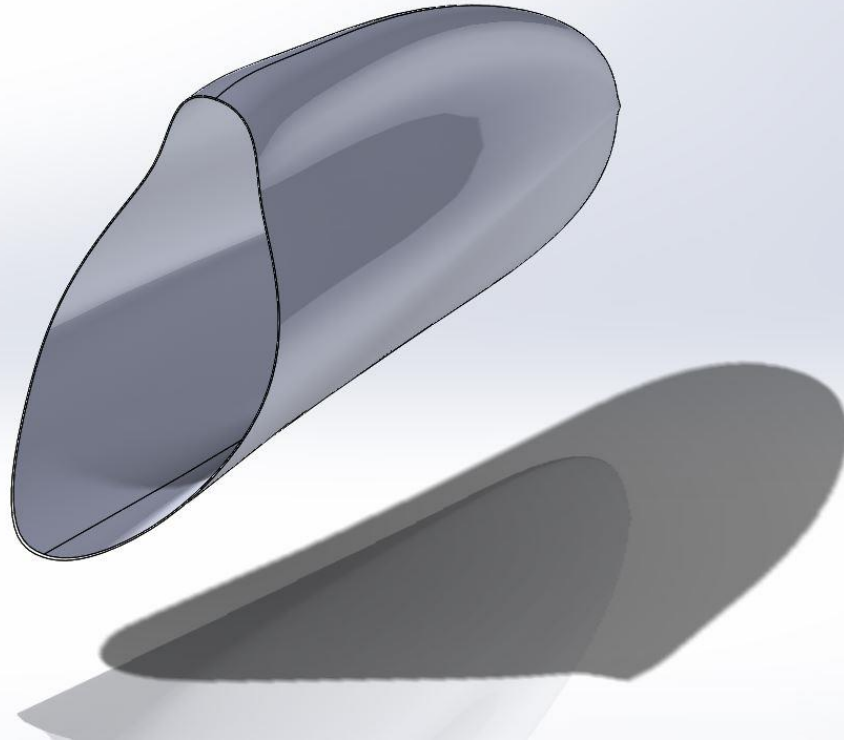
Concept Generation: Fairing

- Design Concepts
 - Front fairing
 - Tail fairing
 - Full fairing

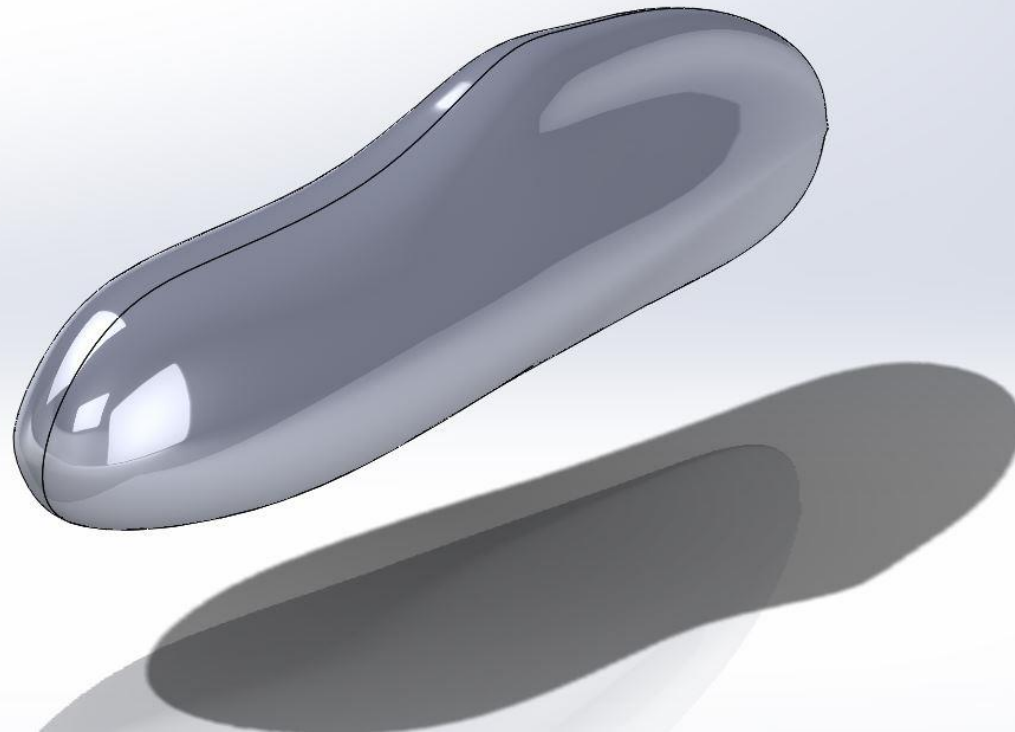
Front Fairing



Tail Fairing



Full Fairing



Concept Selection: Fairing

- Full Fairing
 - Lower C_d
 - Weather protection
 - Higher speeds
 - Rider protection
 - Security

Innovation

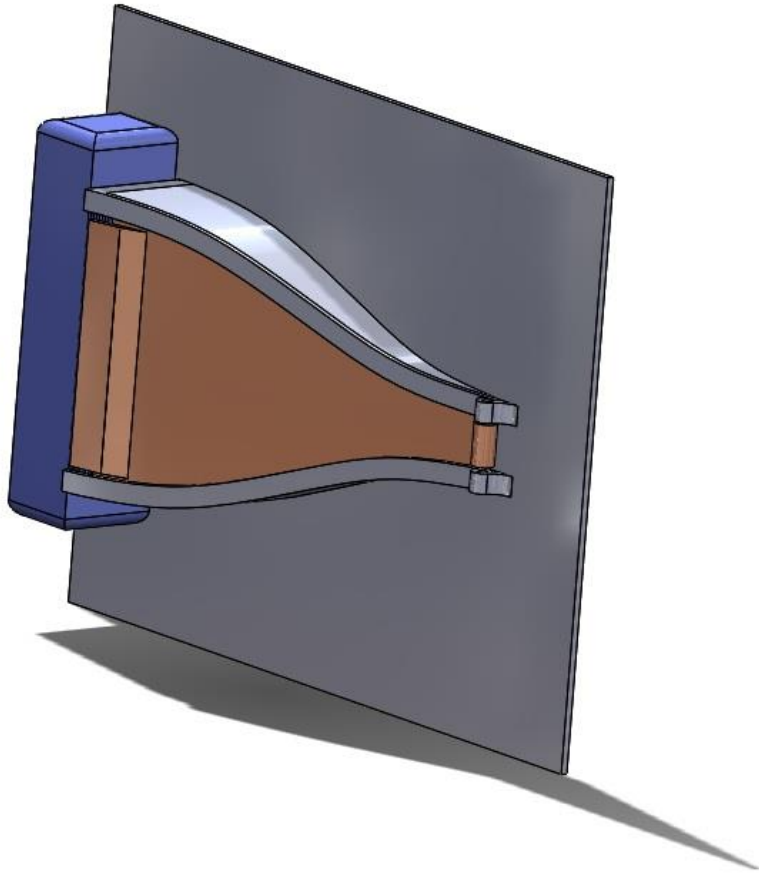
- Weather proofing
- Safety
- Sustainable manufacturing

Weather Proofing

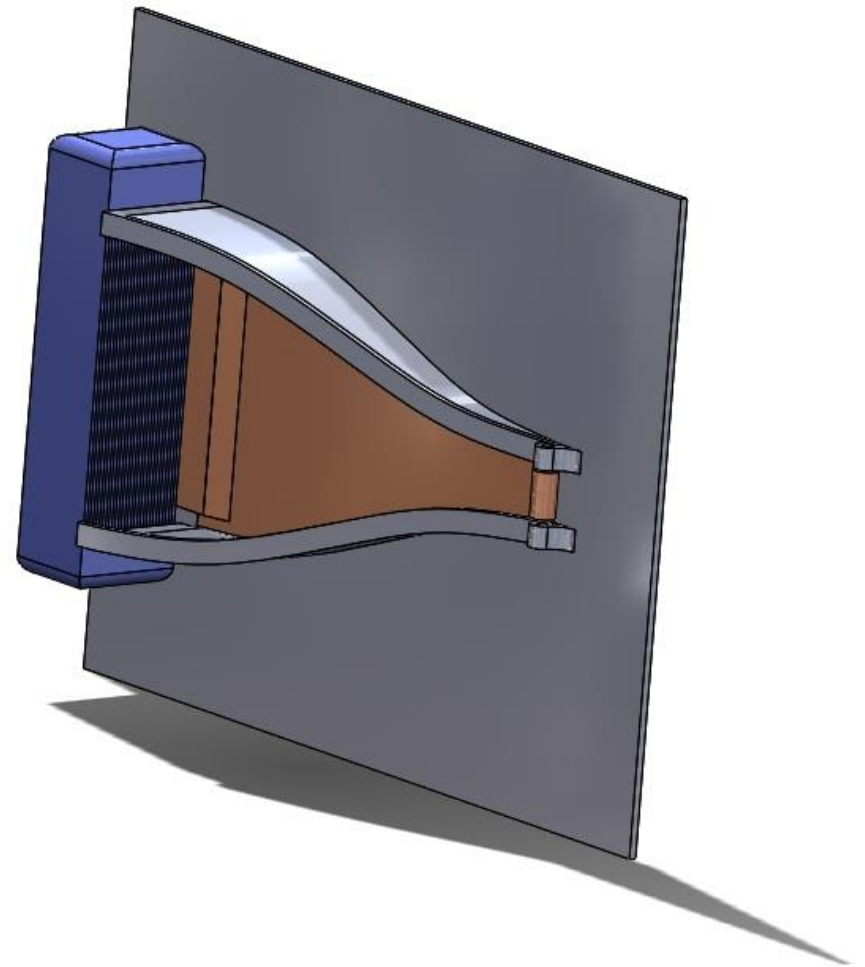
- Rider volume is sealed off from exterior
- Coated wind shield
- Anti fog ducting
- Interior climate control

Interior View

Open

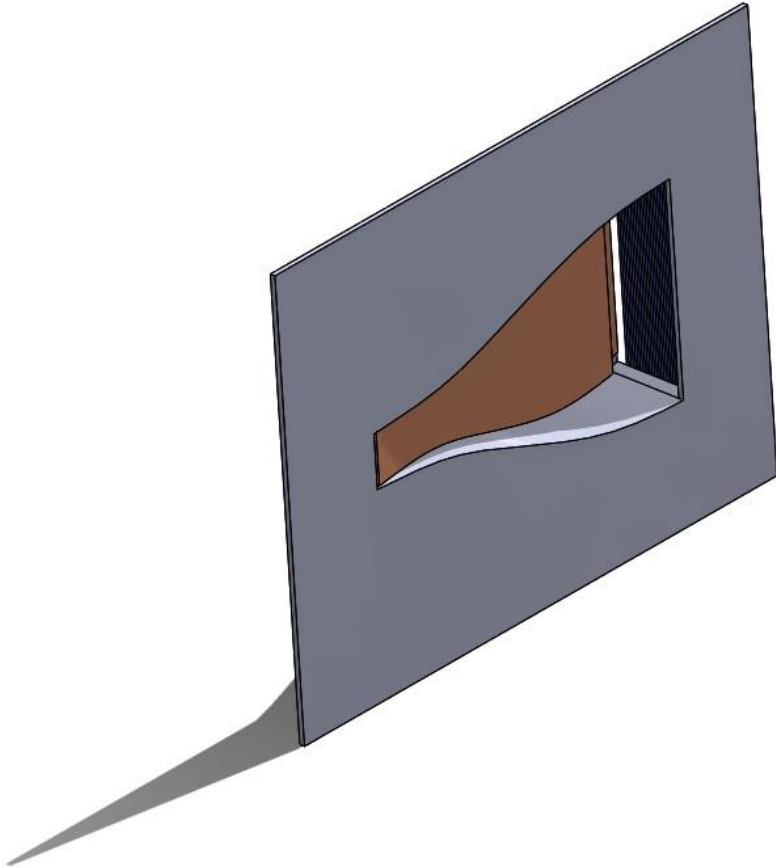


Closed

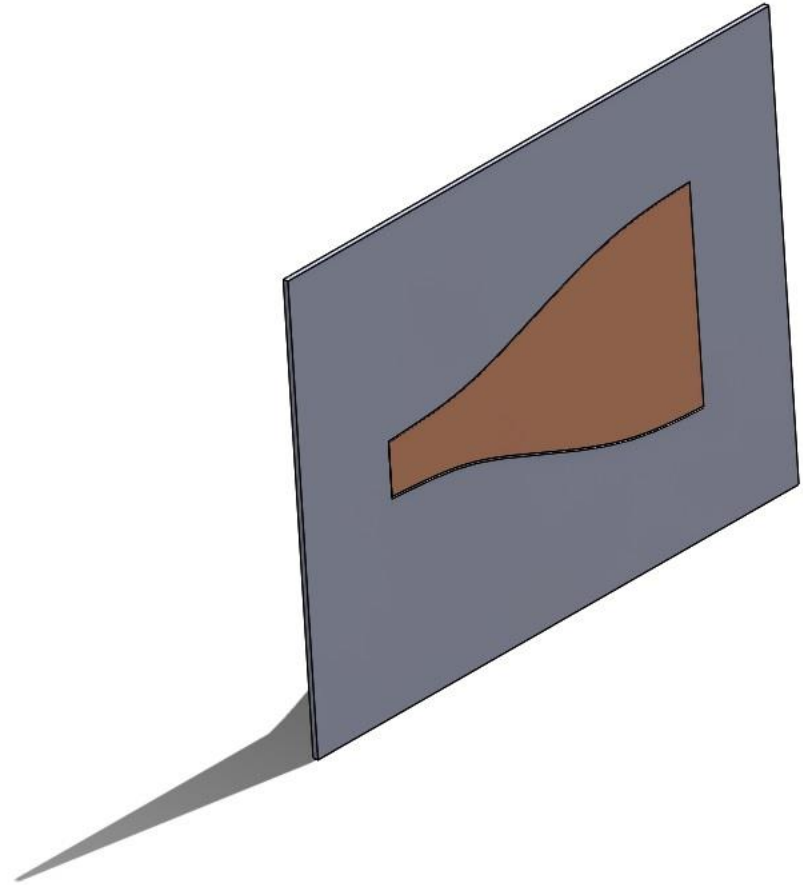


Exterior View

Open



Closed



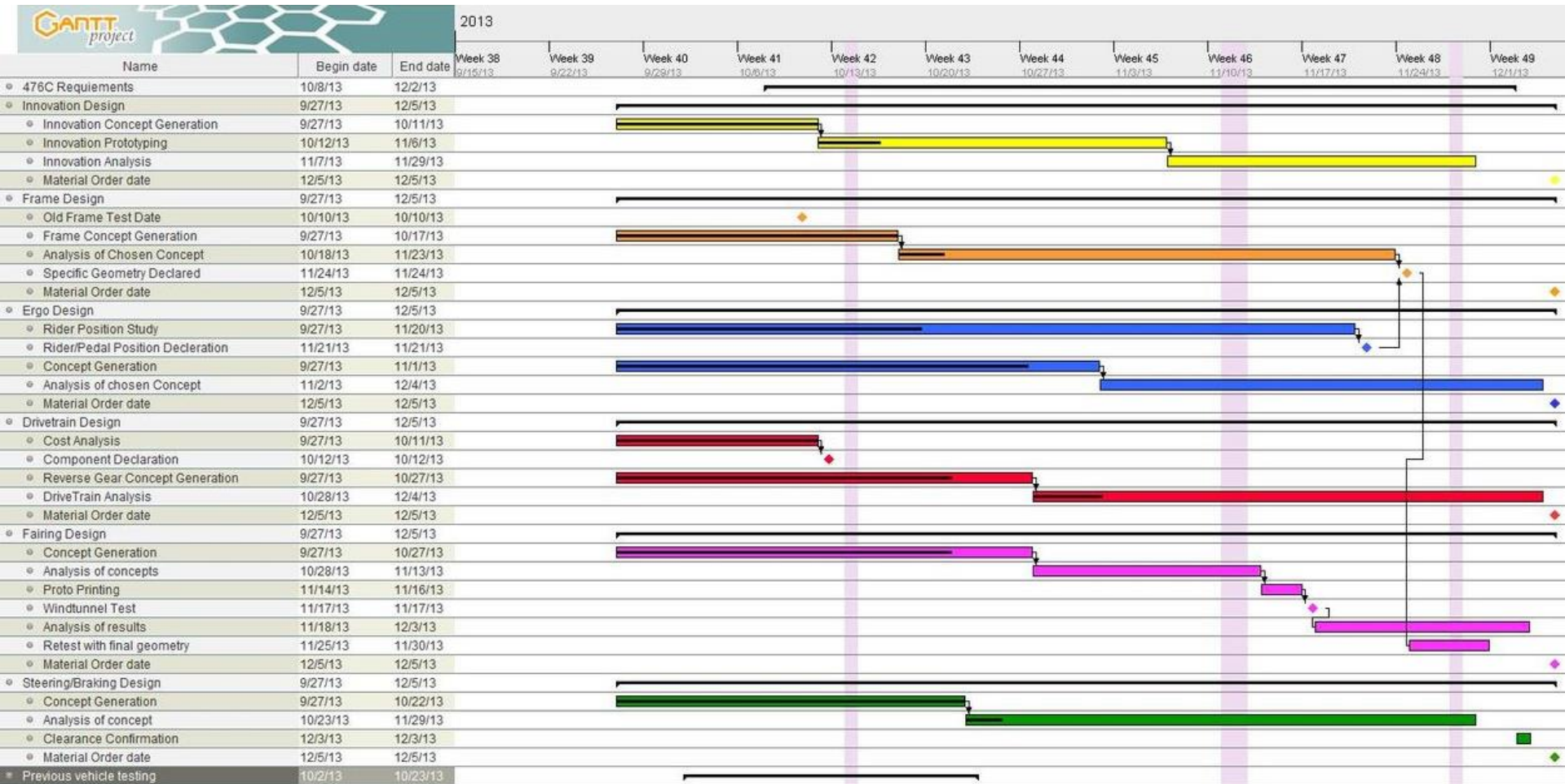
Safety

- Fully functional light system
 - Headlight, tail lights, turn signals
- Foldable side view mirrors

Sustainable Manufacturing

- Low waste production
- Recycling
 - Scrap carbon fiber
 - Plastic remolding
 - Aluminum chip - plastic composite testing
 - Melted chip castings

Project Plan Gantt Chart



Conclusion

- The vehicle will be fully faired with a rectangular center tube frame.
- The steering will use a bell crank push pull system.
- The drivetrain will contain step up gear configuration with an integrated reverse gear.
- Rider position will be evaluated through use of a test rig.
- The vehicle will have innovative aspects in weather proofing, safety, and sustainable manufacturing.

References

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Questions?