# Human Powered Vehicle Project Plan

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# Overview

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# Project Introduction

- Client
  - Perry Wood
    - Instructor for Mechanical Engineering department at NAU
    - NAU ASME Advisor
  - ASME
    - Human Powered Vehicle Challenge

# Need Statement

There is no current form of transportation that provides the benefits of bicycle commuting, while offering the practicality of automobiles.

# Project Goal

Design a human powered vehicle that can function as an alternative form of transportation.

# Objectives

- Vehicle can reach high speeds
- Light weight
- Highly maneuverable
- Cargo space
- Supports cargo weight

# Objectives

- Large field of view
- Protects rider in case of roll over
- Aerodynamic
- Production run manufacturability
- Fits diverse range of operators

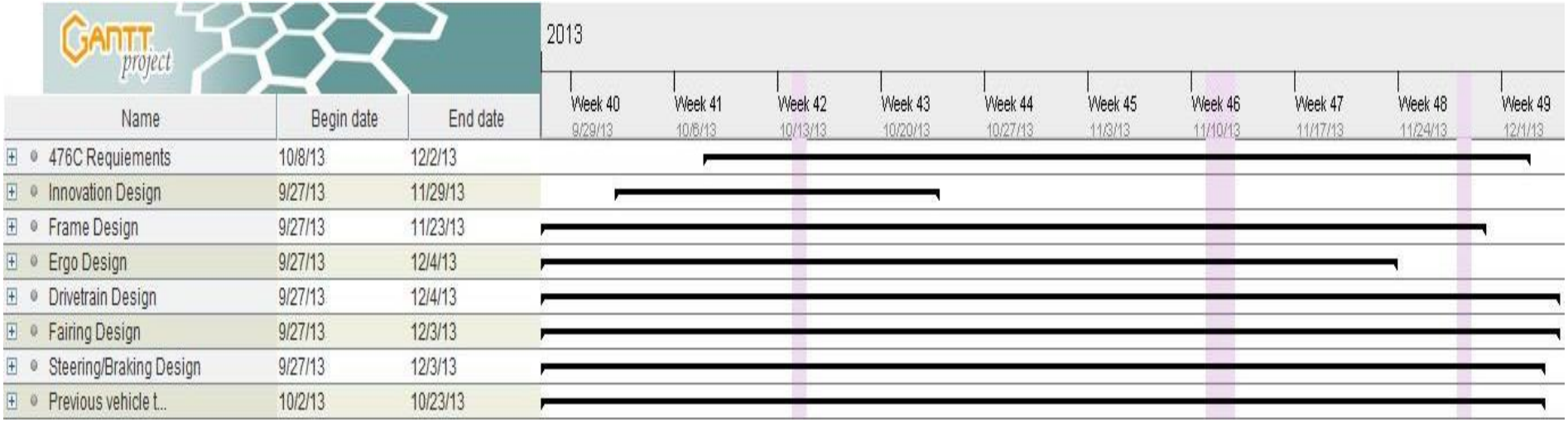
**Table 1-** Competition Constraints

| ASME Competition Constraints | |
|---|---|
| Turning radius ≤ 26.25 ft (8 m) | |
| Completing 6.21 mi (10km) in under 2.5 hours | |
| Roll protection system | Withstand 600 lbf (2670 N) at angle of 12° from vertical with < 2 in (5.1 cm) deflection |
| | Withstand 300 lbf (1330 N) side load with < 1.5 in (3.8 cm) deflection |
| Must have a seat belt | |
| Field of view must equal or exceed 180° | |
| Traverse a 5% uphill or 7% downhill | |
| Carry a 12 lbf (5.5 kg) parcel of 15 X 13 X 7.9 in (38 X 33 X 20 cm) | |
| Stop at a speed of 15.5 mph (25 km/h) in a distance ≤ 19.7 ft (6 m) | |
| Head lights, tail lights, side view mirrors, reflectors, horn | |

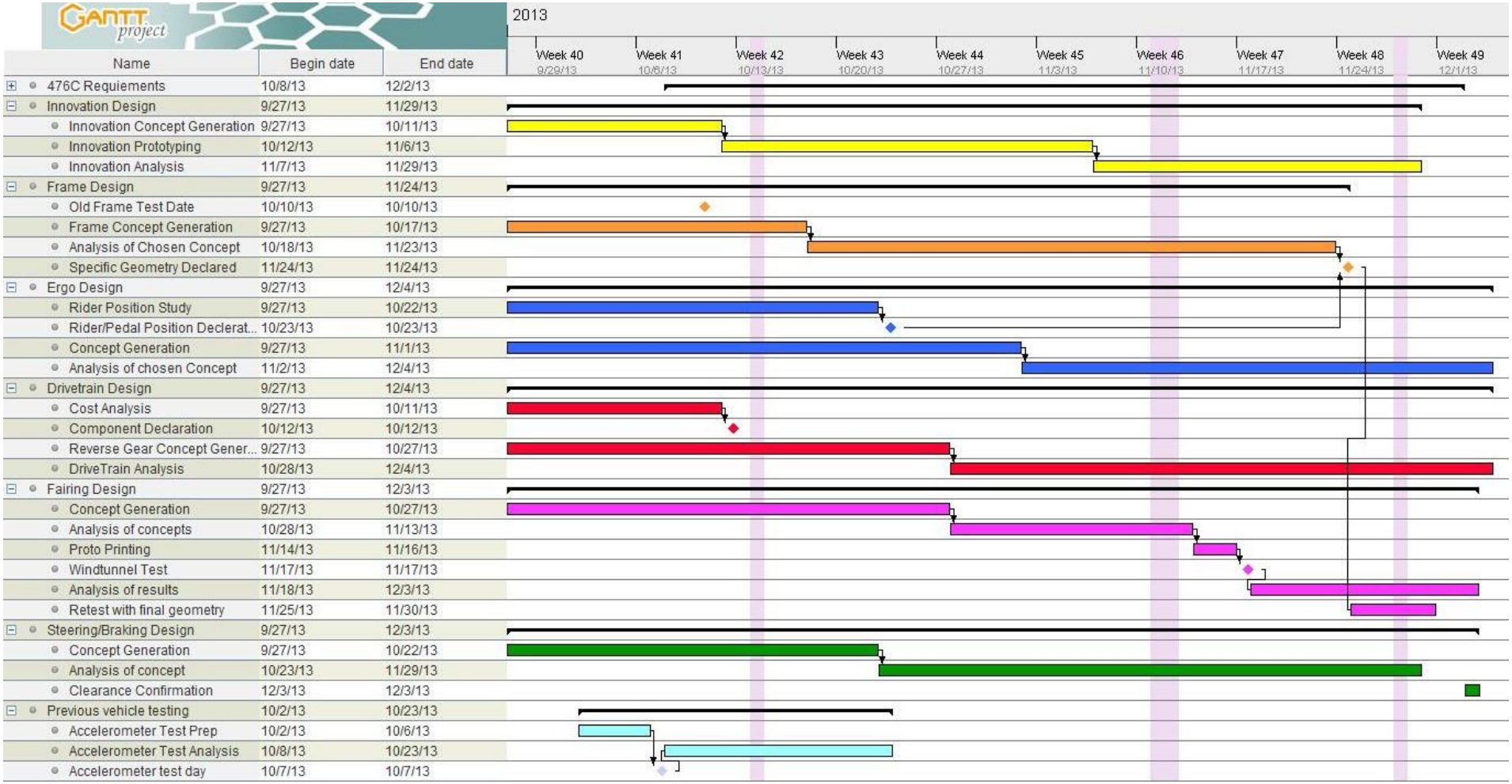
**Table 2-** Costumer Constraints

| Costumer Constraints |
| --- |
| Capable of exceeding 40 mph (64.4 km/h) |
| Vehicle weight ≤ 80 lbf (36.3 kg) |
| Coefficient of drag times the area less than that of a traditional cyclist |
| Development budget of $6,500.00 |

**Figure 1-** Schedule Overview



# **Figure 2-** Detailed Project Schedule




| Name | Begin date | End date |
|---|---|---|
| 476C Requiements | 10/8/13 | 12/2/13 |
| Innovation Design | 9/27/13 | 11/29/13 |
| Innovation Concept Generation | 9/27/13 | 10/11/13 |
| Innovation Prototyping | 10/12/13 | 11/6/13 |
| Innovation Analysis | 11/7/13 | 11/29/13 |
| Frame Design | 9/27/13 | 11/24/13 |
| Old Frame Test Date | 10/10/13 | 10/10/13 |
| Frame Concept Generation | 9/27/13 | 10/17/13 |
| Analysis of Chosen Concept | 10/18/13 | 11/23/13 |
| Specific Geometry Declared | 11/24/13 | 11/24/13 |
| Ergo Design | 9/27/13 | 12/4/13 |
| Rider Position Study | 9/27/13 | 10/22/13 |
| Rider/Pedal Position Declerat... | 10/23/13 | 10/23/13 |
| Concept Generation | 9/27/13 | 11/1/13 |
| Analysis of chosen Concept | 11/2/13 | 12/4/13 |
| Drivetrain Design | 9/27/13 | 12/4/13 |
| Cost Analysis | 9/27/13 | 10/11/13 |
| Component Declaration | 10/12/13 | 10/12/13 |
| Reverse Gear Concept Gener... | 9/27/13 | 10/27/13 |
| DriveTrain Analysis | 10/28/13 | 12/4/13 |
| Fairing Design | 9/27/13 | 12/3/13 |
| Concept Generation | 9/27/13 | 10/27/13 |
| Analysis of concepts | 10/28/13 | 11/13/13 |
| Proto Printing | 11/14/13 | 11/16/13 |
| Windtunnel Test | 11/17/13 | 11/17/13 |
| Analysis of results | 11/18/13 | 12/3/13 |
| Retest with final geometry | 11/25/13 | 11/30/13 |
| Steering/Braking Design | 9/27/13 | 12/3/13 |
| Concept Generation | 9/27/13 | 10/22/13 |
| Analysis of concept | 10/23/13 | 11/29/13 |
| Clearance Confirmation | 12/3/13 | 12/3/13 |
| Previous vehicle testing | 10/2/13 | 10/23/13 |
| Accelerometer Test Prep | 10/2/13 | 10/6/13 |
| Accelerometer Test Analysis | 10/8/13 | 10/23/13 |
| Accelerometer test day | 10/7/13 | 10/7/13 |

# **Table 1-** QFD

| | | Engineering Requirements | | | | | | | | | Bench Marks | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Yield Strength | Deformation | Cost | Velocity | Coefficient of Drag, Cd·A | Volume | Degree | Distance | Weight | The AXE (2012-2013) | Rose Hulman |
| Customer Requirements | Reach high speeds | | | | x | | | | | | x | x |
| | Light weight | | | x | | | | | | x | | x |
| | Maneuverable | | | | | | | | x | x | x | |
| | Carry cargo | | | | | | x | | | x | x | x |
| | Large field of view | | | | | | | x | | | | |
| | Protect rider | x | x | | | | | | | | | x |
| | Aerodynamic | | | | x | x | | | | | x | x |
| | Manufacturability | | | x | | | | | | | | x |
| | Range of rider sizes | | | | | | x | | | x | x | |
| | Units | psi (kpa) | in (m) | $ | ft/s (m/s) | in^2 (m^2) | in^3 (m^3) | ° | ft (m) | lbf (kg) | | |
| | | Engineering Targets | | | | | | | | | | |

# Conclusion

- A human powered vehicle will be designed to provide the practicality of an automobile, while having the benefits of a bicycle.
- Client is Instructor Perry Wood and ASME Human Powered Vehicle Challenge.
- Vehicle will be safe, efficient, and manufacturable on a large scale.

# References

American Society of Mechanical Engineers, *Rules for the 2014 Human Powered Vehicle Challenge* (2014) [Online]. Available: https://community.asme.org/hpvc/m/default.aspx

# Questions?