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(All are graduating with degrees in Agricultural Engineering-Machine Systems)

Background

The ASABE hosts the International 1/4 Scale Tractor Student Design Competition each year where 27 universities build a tractor and compete in a unique 360-degree workplace experience. Teams are only given an engine and rear tires and the rest must be designed following strict rules similar to design standards. The Purdue Quarter Scale (PQS) team strives to deliver a tractor that focuses on manufacturability, serviceability, maneuverability, safety and ergonomics.

Project Goals

The team's goals for this tractor design are:

- Drivetrain capable of 2700 lb. chain load
- Simplified operator station- fewer and less complicated parts
- Real time speed feedback
- Operating noise below 90dB

Design Constraints

Each team of engineers were constrained by the rules of the ASABE 1/4 Scale Tractor Student Design Competition. The design constraints were:

- Weight – Tractor may not exceed 800 lbs. maximum gross vehicle weight
- Length – No part of the tractor may protrude further forward than 96 inches from the center of the rear axle
- Width – No part of the tractor may be wider than 72 inches

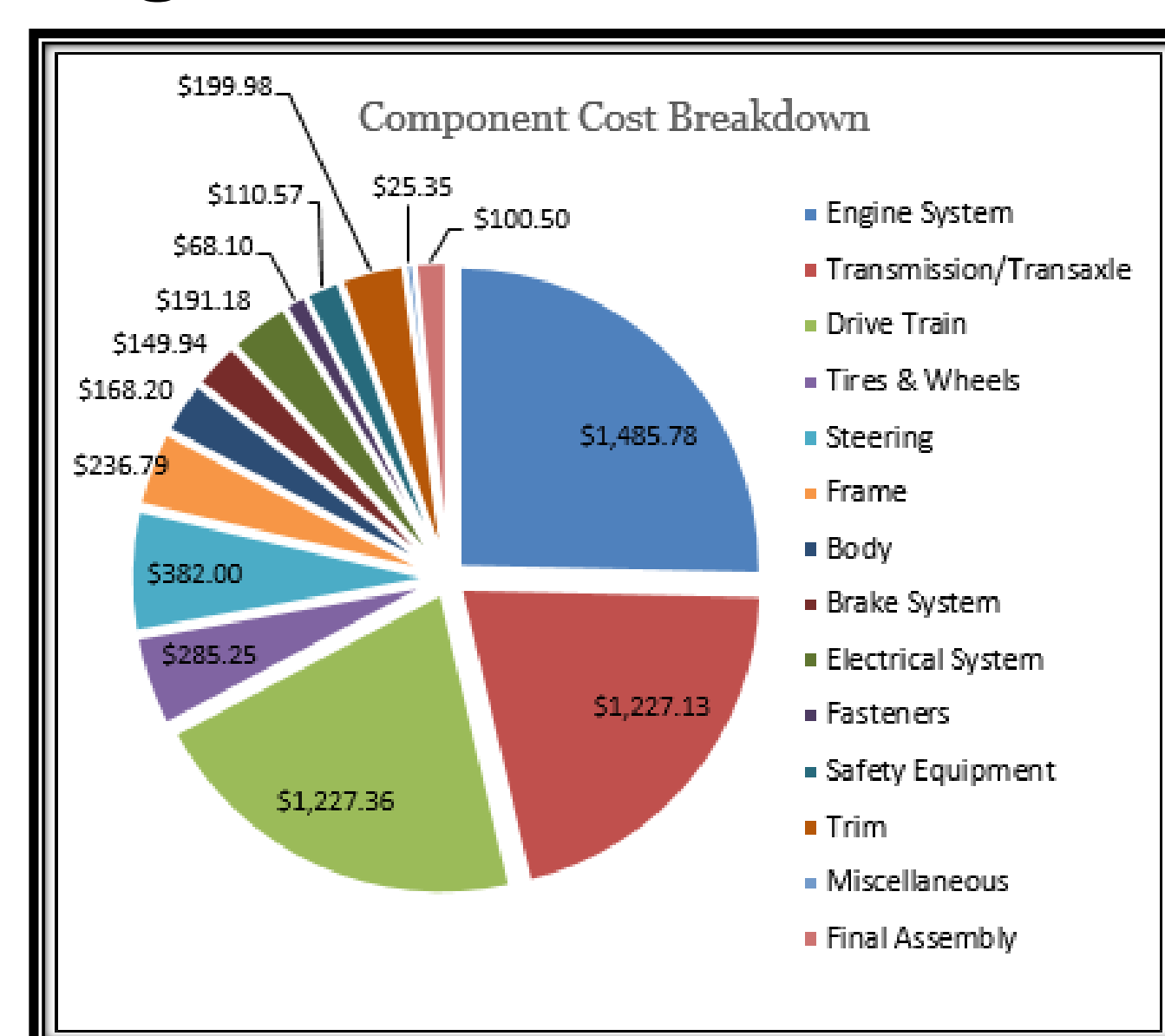
There are several other limitations and rules that the team must meet to qualify for the competition, regarding component design, safety, noise, etc.

Impact and Sustainability

- New designs reduce number of components and shielding
 - Simplified drivetrain and operator station
- Fluid drainage tubes to ensure controlled disposal
- Light weight, 4x4 drivetrain reduces soil compaction and yard damage.

Economic Analysis

- Cost breakdown uses ASABE competition pricing constants
- 3.5% reduction in adjusted manufacturing cost from 2016 tractor
- Engine, transmission, and drivetrain account for 53% of costs



Summary	
Manufacturing Variable Cost	\$ 5,858.14
Period Manufacturing Cost (14%)	\$ 820.14
Research & Development (5%)	\$ 292.91
Estimated Full Production Units	3000
Adjusted Manufacturing Cost	\$ 6,971.18
Suggested List Price	\$ 7,755.00
Profit Margin	10%
Yearly Net Profit	\$ 2,351,448
Total Number of Parts	185
Tractor Weight	750 lbs

Customer Requirements

Competitive tractor pullers

- Durable drivetrain
- Serviceable design
- Safe and easy to control
- Maximize gear ratio

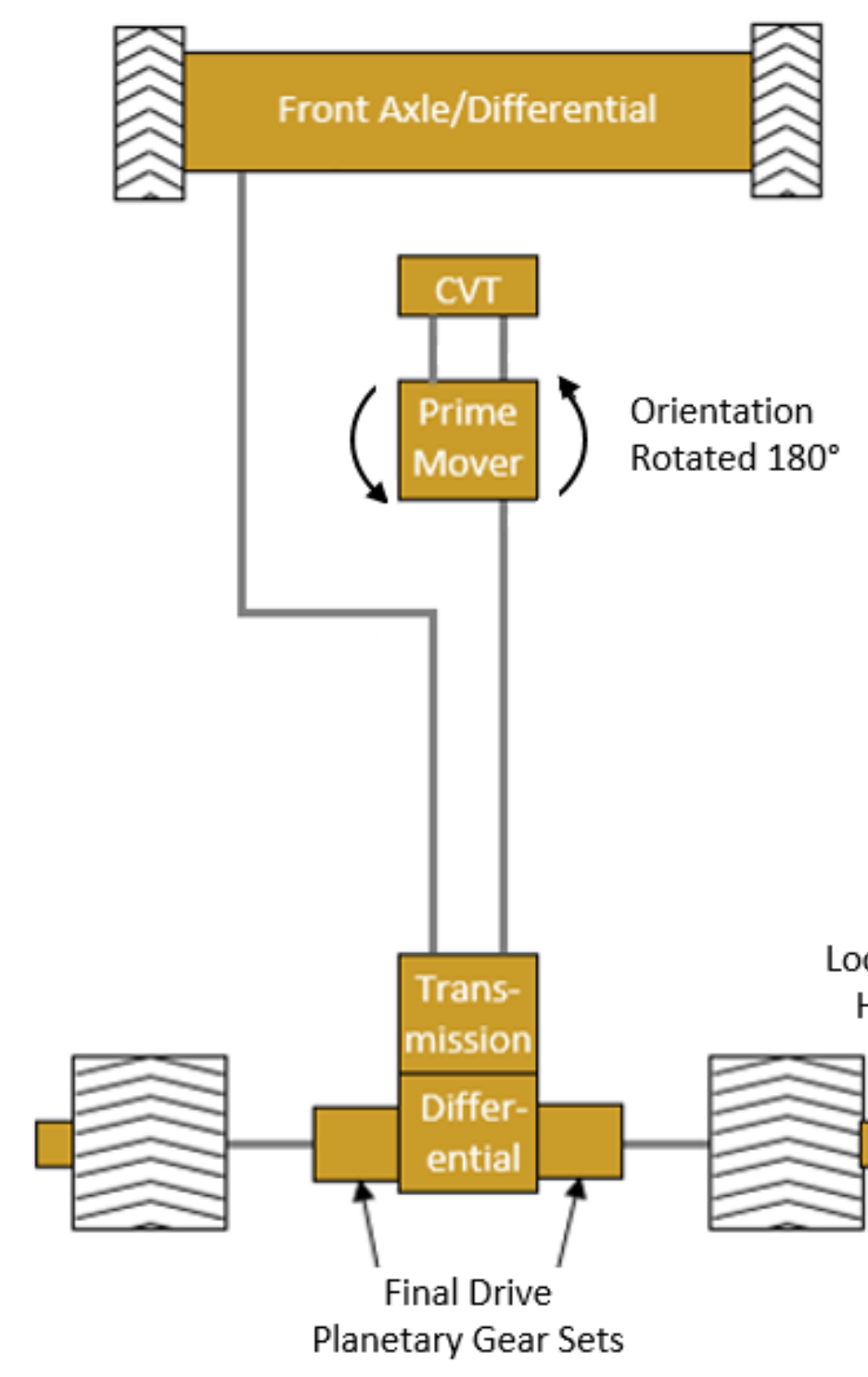


Drivetrain

Objective: Increase reliability & Reduce noise.

- Simplified drivetrain:
 - Cub Cadet3 speed w/ reverse transaxle
 - Final drives and lock out hubs
 - Continuously variable transmission (CVT)
 - 4WD Kubota front axle
- Engine orientation rotated 180°
 - Eliminates need for transfer case
- 5% weight reduction

Alternative designs: 2WD, actuating CVT, hydrostatic transmission, electronic locking differential

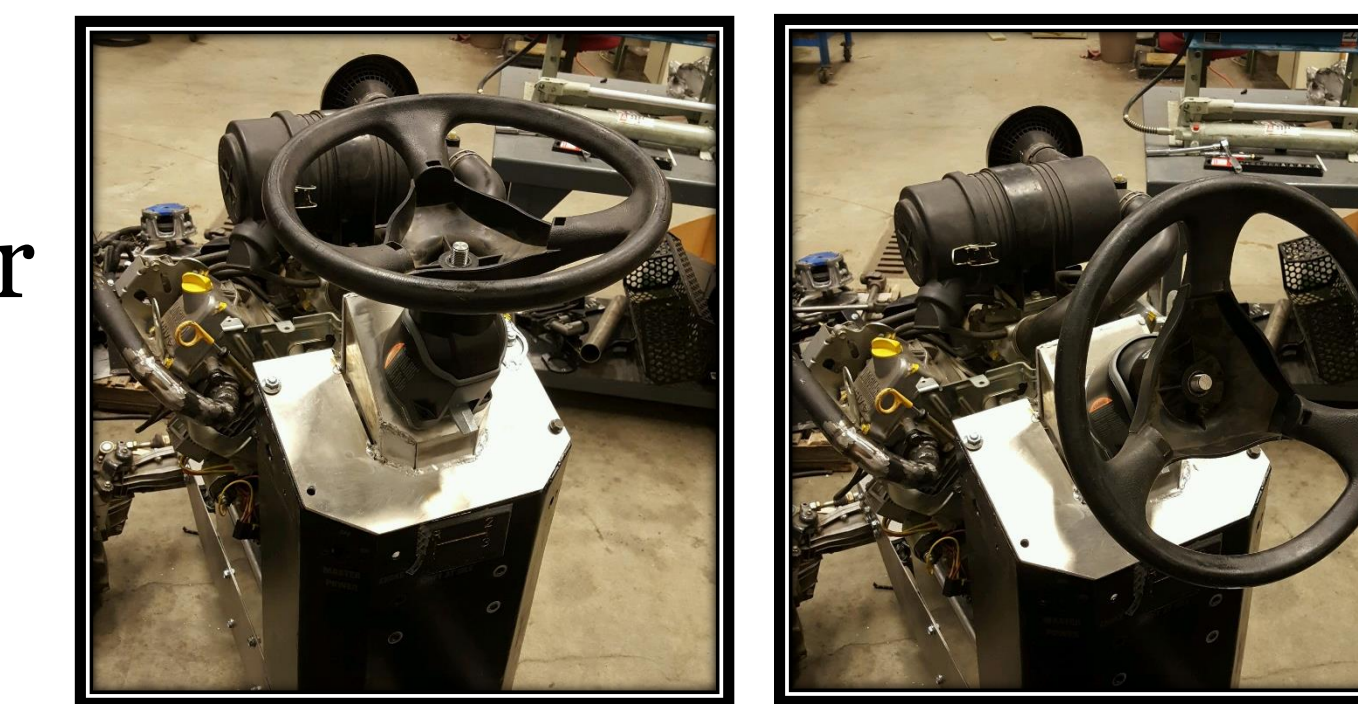


Operator's Station

Objective: Simplify Steering System.

- Closed loop hydraulic steering system
 - Eliminates hydraulic pump and reservoir
 - 7% weight reduction
- Suspension operator station
- Tilt Helm and adjustable seat
- Accommodates a 95th percentile operator

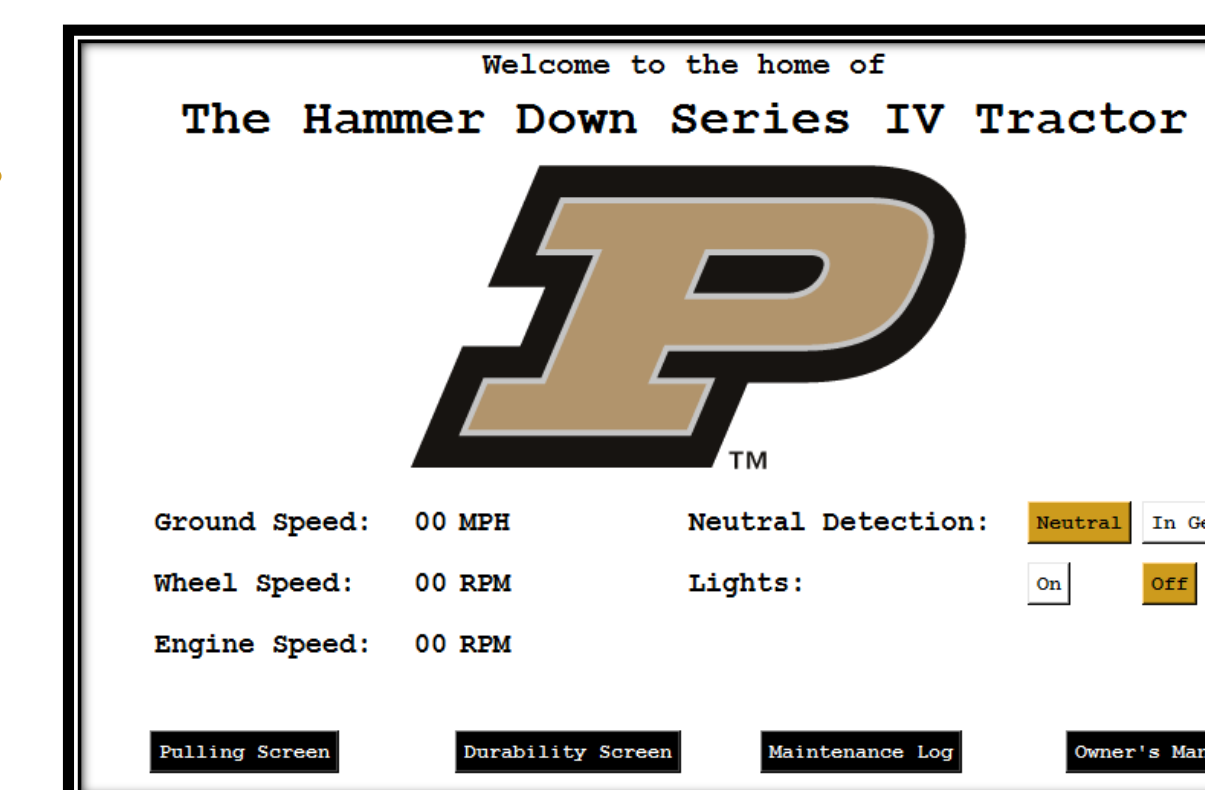
Alternative designs: electronic steering, electric throttle



Data Acquisition & Electronics Interface

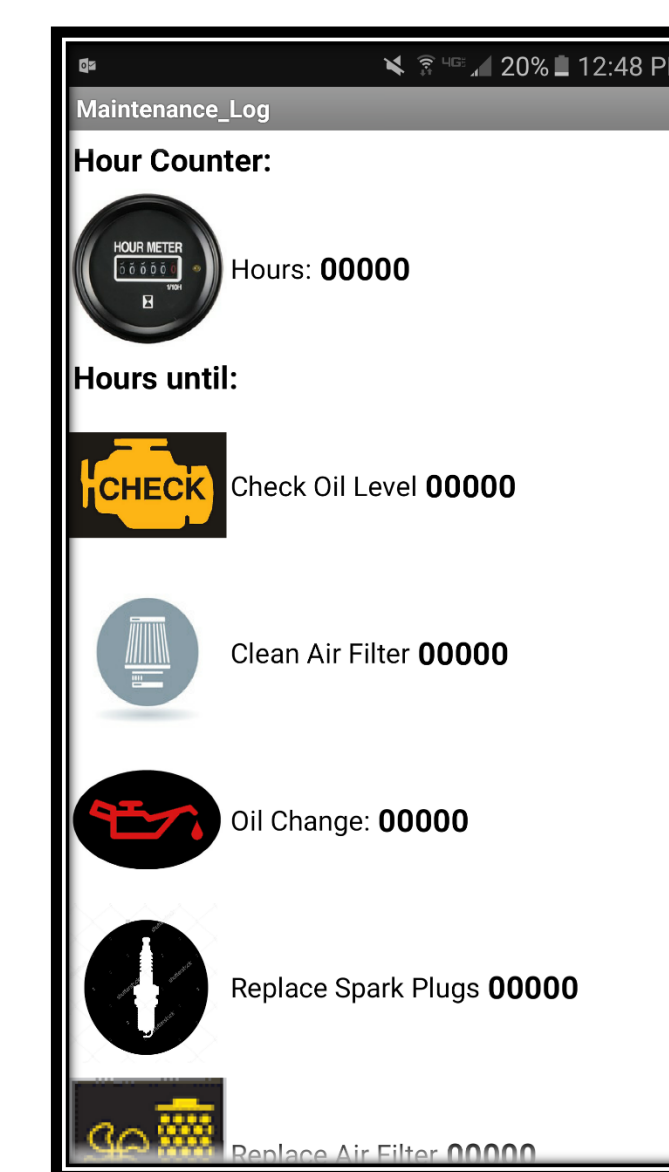
Objective: Provide real time performance feedback, data logging, and electronic controls.

- Real Time feedback
 - Engine speed
 - Wheel speed
 - Ground speed
- Basic touch screen controls
- Access to operators manual and maintenance log
- Phone application provides mobile feedback



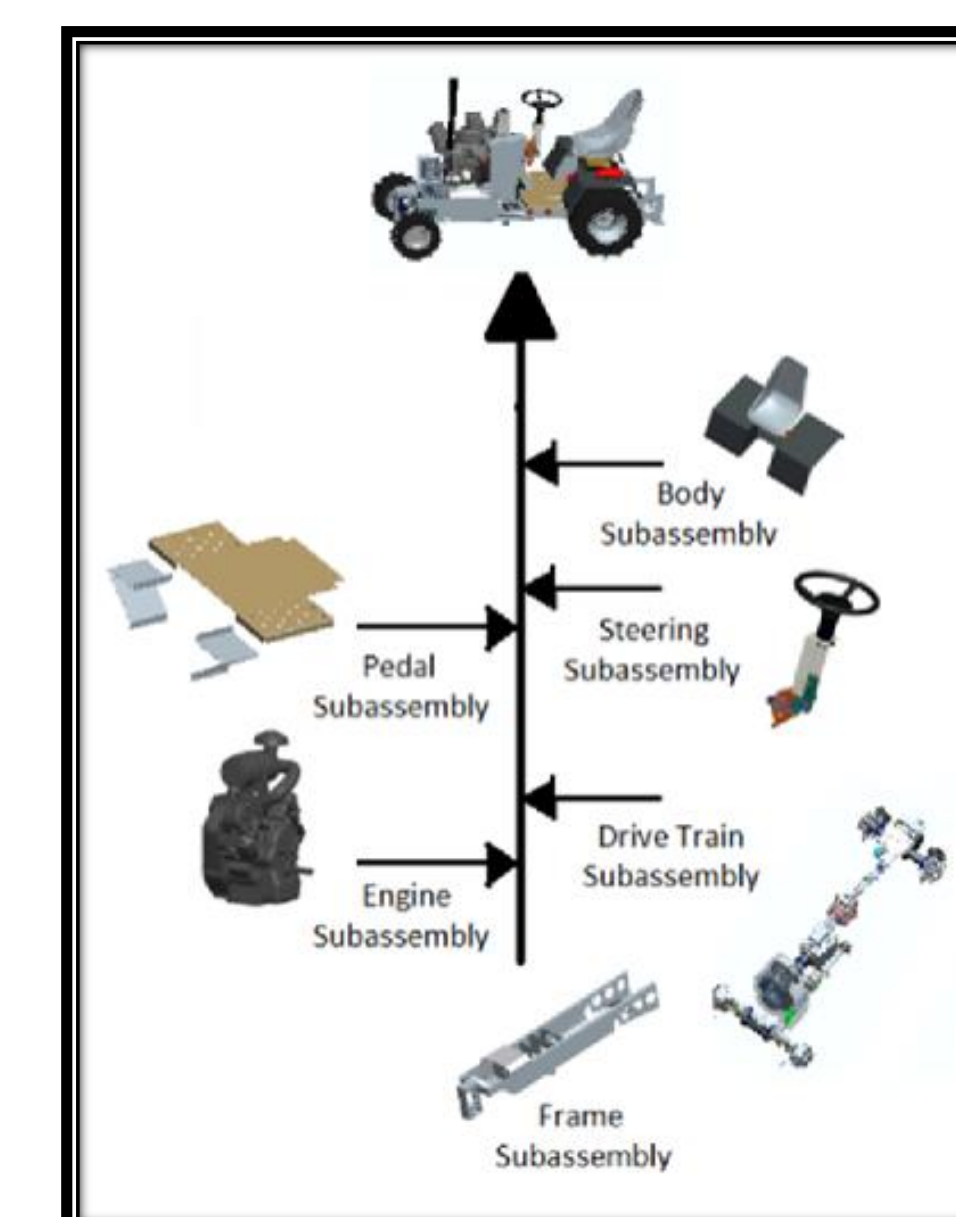
Serviceability

- Simplified shielding
- Accessible without removing tractor shielding
- Maintenance log available
- Tractor display monitor or android app
- Minimal hardware variations



Manufacturability

- Simplified shielding
- Common materials and fasteners
- CNC plasma cutter, press brake, and powder coating
- Creo modeling and subassembly technique

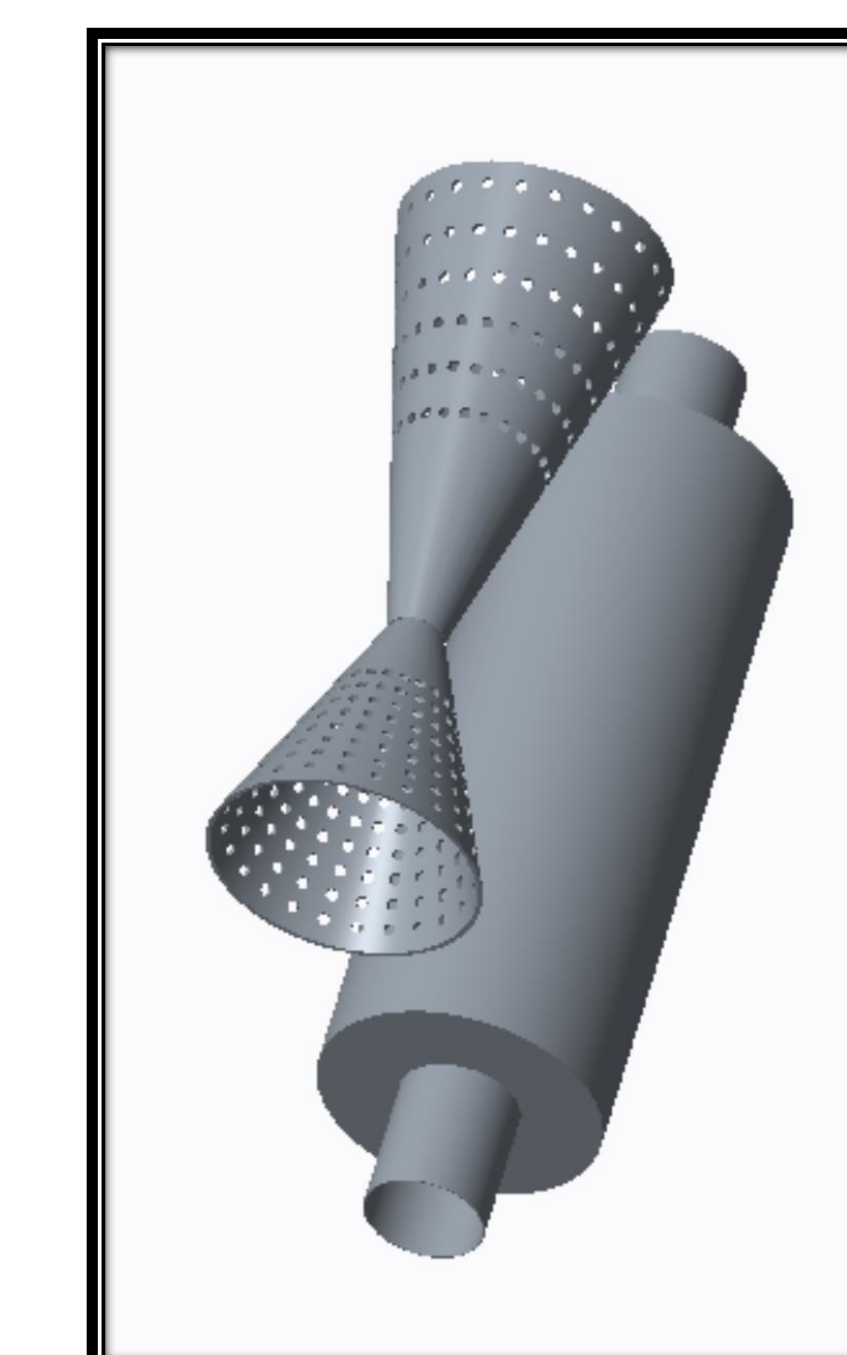


Exhaust System

Objective: Minimize operating noise.

- Twin muffler system
 - 27% noise reduction
- Shielding allows maximum heat dissipation and safe operation
- Multiple exhaust packages in order to meet customer needs

Alternative designs: delta/vortex flow exhaust, added heat absorption material



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