Problem Statement and Background

- A new, lower priced design needs to be developed to reach smallholder farmers and extend the PUP project into new markets.
- The team has been tasked with designing a frame for this new vehicle.
- Purdue has partnered with ACREST to provide an affordable utility vehicle for local transportation of water, crops, and supplies while being able to power attachments.
- The PUP design has been finalized at a build cost of $1500-$2000 USD.
- This price is higher than what a typical smallholder farmer in Sub-Saharan Africa can afford.
- The new design, a MiniPUP, needs to have many of the qualities of the PUP such as carrying heavy loads, traversing rough roads, and being manufactured locally.

Impact on Society and Sustainability

- Team will travel to Cameroon to reproduce the design in the future using only locally available resources.
- The MiniPUP will be used on a day-to-day basis by ACREST hauling food, water, supplies, etc.
- The vehicle will reduce smallholder farmer labor challenges and improve productivity and food security.
- Reproducing this design locally on a micro-factory scale creates sustainable employment opportunities.
- The MiniPUP can also run attachments such as a maize grinder or a water pump which will turn it into a mobile power unit.

Alternative Solutions

Component Layout Decision

- Four ideas for the general layout were developed.
- These included placement of the engine, driver, number of wheels, direction of driving, suspension options, and steered wheels.
- The four options are as follows: Traditional (1), Person in Back (2), Person Standing in Back (3), Car-Like (4).
- A weighted design matrix was developed and eventually eliminated (4), convinced us to further investigate (1), and then eliminate (1).
- The final chosen layout was a combined (2) and (3) (1).

Frame Choice

- For the frame, there were three ideas:
  - They are: triangular, trapezoidal, box.
  - The final decision was to combine the trapezoidal and the box due to cost and ease of building.

Trapezoidal

Trangular

Box

Final

Cost Analysis

- The prototype was made for less than what the goal price was.
- The design has less than ½ of the amount of angle iron of the full PUP (363 vs 170).
- For this prototype the team didn’t need to find rims, tires, the strut, transaxle, driver controls, or pedals which will increase the cost in the future unless the team obtains most of the parts from some scrap.
- The price of making 20 will be much lower than the prototype cost due to the discount for buying many parts at once (eg. buying 10 engine for $50/each).

Final Design

- Both of the senior design goals were met.
- The prototype frame uses 46.8% of the angle iron that the original PUP does.
- The team completed a prototype of the frame and has the needed parts to finish the prototype for testing.
- The team spent less than $750 on the prototype.
- The ANSYS analyses that were made can be used as a tool to further develop the MiniPUP frame design in the future.