MiniPUP IV (Purdue Utility Platform)

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**Problem**
The current MiniPUP III design is more complicated than necessary and has a retail price that is too high for small farmers in developing countries.

**Background**
Approximately 300 million Africans struggle on a day to day basis with obtaining the proper nutrients they need to survive. The MiniPUP IV is a good solution to develop small farms by providing strong reliable mechanization that will enhance their yield and their ability to harvest crops while maintaining a price point that is suitable for buyers.

- Continuing project since 2009
- Previous PUPs are operating daily in various African countries

**Purpose**
To design a vehicle that must be built in developing countries with limited access to parts and tools. The design must be low cost to manufacture and must be assembled easily and efficiently. Furthermore, the design must be able to power attachments and pull implements.

**Value Proposition**

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>MSRP</th>
<th>Carrying Capacity (ft³)</th>
<th>Storage Space (compared to PUP)</th>
<th>PTO to Power Attachments</th>
<th>Pulls Implements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-PUP</td>
<td>$1,500</td>
<td>1000</td>
<td>Comparable</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PUP</td>
<td>$4,500</td>
<td>2000</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pickup Truck</td>
<td>$40,000</td>
<td>2000</td>
<td>Comparable</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Car</td>
<td>$20,000</td>
<td>1000</td>
<td>Small</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>2-Wheel Tractor</td>
<td>$6,000</td>
<td>na</td>
<td>na</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Tractor</td>
<td>$2,500</td>
<td>1750</td>
<td>Small</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Bicycle</td>
<td>$100</td>
<td>200</td>
<td>Very Small</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

**Design Constraints and Criteria**
- Power attachments and pull implements
- Cost less than $750
- Carry 1000 lbs. payload
- Manufacturable in-country

**Alternative Solutions**
1. Existing MiniPUP – Complex truss with expensive three-wheel suspension
2. Overhead front wheel mount – Simple frame with no suspension
3. Flatbed – Ladder frame with front suspension only

**Analysis of Final Solution**

- **FEA Simulations:**
  - Cargo loads
  - Side loads
  - Draft loads
  - Point loads

- **Driveline Analysis:**
  - Gear ratios
  - Pulley diameters
  - Belt sizes
  - Tire diameters

- **Corner Point Load – Torsional Stress**
- **Impact Load – Racking of Frame**

**Conclusion**
The flatbed, ladder frame design for the MiniPUP drastically reduces the manufacturing time, which reduces the cost of the product. This allows more farmers to enter the market of mechanization. Small farms will be able to adopt the technology thus increasing their yields and overall utility.

- Projected decrease in weight: 84lbs
- Decreased cost by ~$150.00
- Increased payload area by ~ 8.5 ft² (39%)
- Lowered center of gravity by ~1.5 inches (6%)

**Impacts**
- Global – scalable to any developing country
- Social – improves standard of living
- Cultural – easily integrates without change
- Environmental – recycles scrap materials
- Safety – shielding of moving parts
- Health – lowered physical work load

**Recommendations**
Extensive field testing should be conducted to validate simulation results. In addition, the design should be evaluated for comfort and ergonomics with the new suspended seat. Since this is the first iteration with a flatbed frame, it has various points that could be refined, such as: cross member spacing, bed width, operator station, and optimization of steel section size.

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