

BASIC UTILITY VEHICLE

TEAM RUGGEDLY SIMPLE

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Senior Capstone Design

Challenge:

- To design a 3-wheel vehicle based on the rear-end (i.e. the bed, axle, suspension, wheels, frame, etc) of a *small* pick-up truck (Chevy S-10, Ford Ranger, etc) cut near the cab/bed interface.
- To design a rear ambulance unit to be attached to the rolling chassis.
- In addition to cost, design emphasis is on drivetrain, ease of assembly, durability, serviceability, and the ambulance unit itself.
- To design for small scale assembly operations in the developing world that can each produce one vehicle per day. Investment for "micro-factory" must be minimized.

Design Requirements Competition and Rules

Design Objectives:

- Minimize total lifetime cost of ownership
- Utilize off-the-shelf components where possible to minimize part costs.
- Minimize the number of part numbers, and the part count to simplify purchasing, logistics, service, etc.
- Utilize as few as two people to assemble vehicle. Utilize Design For Assembly (DFA) methods
- Utilize simple, durable, low maintenance design
- Minimize center of gravity to help reduce roll-over
- Minimize machining, welding, and fixtures for third world assembly to reduce investment/skill required
- Emphasize safety in all aspects of design. Protect driver and passengers from moving parts
- Emphasize reliability (servicing BUVs in remote locations is difficult)
- Gender friendly: consider women's apparel for driver and passengers, easy starting, etc.

(related to the performance, objectives, and provisions sections of the Design Specification)

Performance Requirements:

- Capable of climbing 20% slope (fully loaded)
- Fording Ability: 15 inches of water
- Brake(s) will lock during an emergency stop (off-pavement, fully loaded)
- 5 minute conversion (or less) from ambulance mode to cargo mode.
- power an on-board water pump at 10 gpm or more.

Specifications – Rolling / Driveable Chassis:

Cost (as a kit): \$1350 for pre-welded kit (all non truck part). Does not include final assembly, freight, duties. Ambulance attachment has separate price target.

Transmission: Type not specified, but no automotive transmissions are allowed. Riding lawn mower transmissions are allowed.

Reverse: Provide a powered reverse (i.e. not human powered)

Hybrid Drive: Permitted but not required. (For example, reverse could be done via an electric motor)

Front frame: 120 lbs (includes all fabricated metal parts, including bearing supports, seat supports, etc)

Payload: 1200 lbs (including driver)

Turn Diameter: < 20 feet (measured wall to wall... as if you were turning on a bridge)

Top Speed: 20 mph on grass (governed)

Front Seat(s): Driver seat must be centered on the vehicle centerline (roughly). A forward passenger seat is optional if it is on the vehicle centerline (i.e. motorcycle seating arrangement).

Throttle: Must be mounted on steering mechanism. Left-hand activation. Center or left side mounting location. If using a finger throttle, add a throttle "brake" guard and label throttle clearly. No foot throttles.

Main Brake: Use existing truck brakes with hydraulic activation via foot pedal.

Parking Brake: Use the existing emergency brake (enable activation of right brake only, & left brake only). Driver must be able to activate it from his seat.

Primary Engine: 8.5-10 hp internal combustion engine (no cost penalty for diesel engines – see costing info)

Steering: Driver must be able to rotate front wheel +50 degrees from centerline while seated.

Ground Clearance: > 10" except at differential, leaf springs, or lower shock mounts

PTO: Extra pulley to provide V-belt power to other devices (on-board or off board). Must be able to operate PTO without jacking up the rear end (i.e. the rear wheels must stay on the ground).

Water Pump: On-board water pump (powered by v-belt). 10 gpm minimum.

Overall Length: <11 ft long, <12 ft if using motorcycle seat arrangement (with driver & forward passenger)

Packaging (front unit): Minimize crate-size required for shipping the front kit alone (welding complete)

Skid Plate: Powertrain components (except truck) must be protected from hi-center (i.e. bottoming out)

Assembly Time: < 6 man-hours to assemble front kit (pre-welded, pre-painted parts) & connect to rear unit. Time does not include cargo bed.

Safety Equipment: Driver seat belt, parking brake, horn, kill switch, tow hook(s) (front), on-board fire extinguisher, patient hand/straps, "anti-roll" protection (shoulder height roll-over bar helps stop vehicle rotation at 45° roll and disallows driver from cargo space), 1 headlight, 2 taillights, 2 brake lights, two light reflectors per side.

Front Suspension: Type not specified. Min 3" wheel travel. Do NOT use a motorcycle front steering unit.

Costing Information:

For engines, use \$24 per horsepower OEM cost (i.e. 10 hp diesel is \$240)

For the rear half of the pick-up truck – use \$150 (no matter what it costs your team)

For purchased parts, use 50% of retail price, for fabricated parts & painting, use industry quotes (based on monthly orders of 100 units/mo.)

Volume assumption for sourcing parts: 1200 BUVs per year.

Use \$2/hour labor rate. Use retail pricing on investment.



2005 BUV Competition

www.drivebu.org

Comparison of US Economy Car VS BUV

System Description	Average US Car		US Economy Car	3rd World Car*	BUV Target
Engine	1810	16%	1,152	823	350
Body and Structural	1850	17%	1,177	841	200
Drivetrain	1600	15%	1,018	727	75
Electronics & Electrical	1490	14%	948	677	0
Interior	1200	11%	764	545	25
Climate Control / Engine Cooling	650	6%	414	295	0
Suspension	400	4%	255	182	100
Steering	375	3%	239	170	50
Braking	325	3%	207	148	75
Pass. Restraints	300	3%	191	136	20
Fuel System	300	3%	191	136	0**
Wheels and Tires	300	3%	191	136	100
Body Glass	200	2%	127	91	0
Exhaust	200	2%	127	91	0**
Total Component Cost	\$11,000	100%	\$7,000	\$5,000	\$995
Retail Price (US\$)	\$20,000		\$8,500	\$7,000	\$1,200

*i.e. Worldstar by World Transport Authority, or Celta by GM Brazil

** included with engine

