

# Team 23: 30 lb. Combat Robot "TRIDENT"

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## Objective

The goal was to design and manufacture a 30 lb combat robot under the constraints set by Robot Battles and LSU, which includes additive manufacturing, that would place first in the 2019 Bengal Bot Brawl and the national competition.

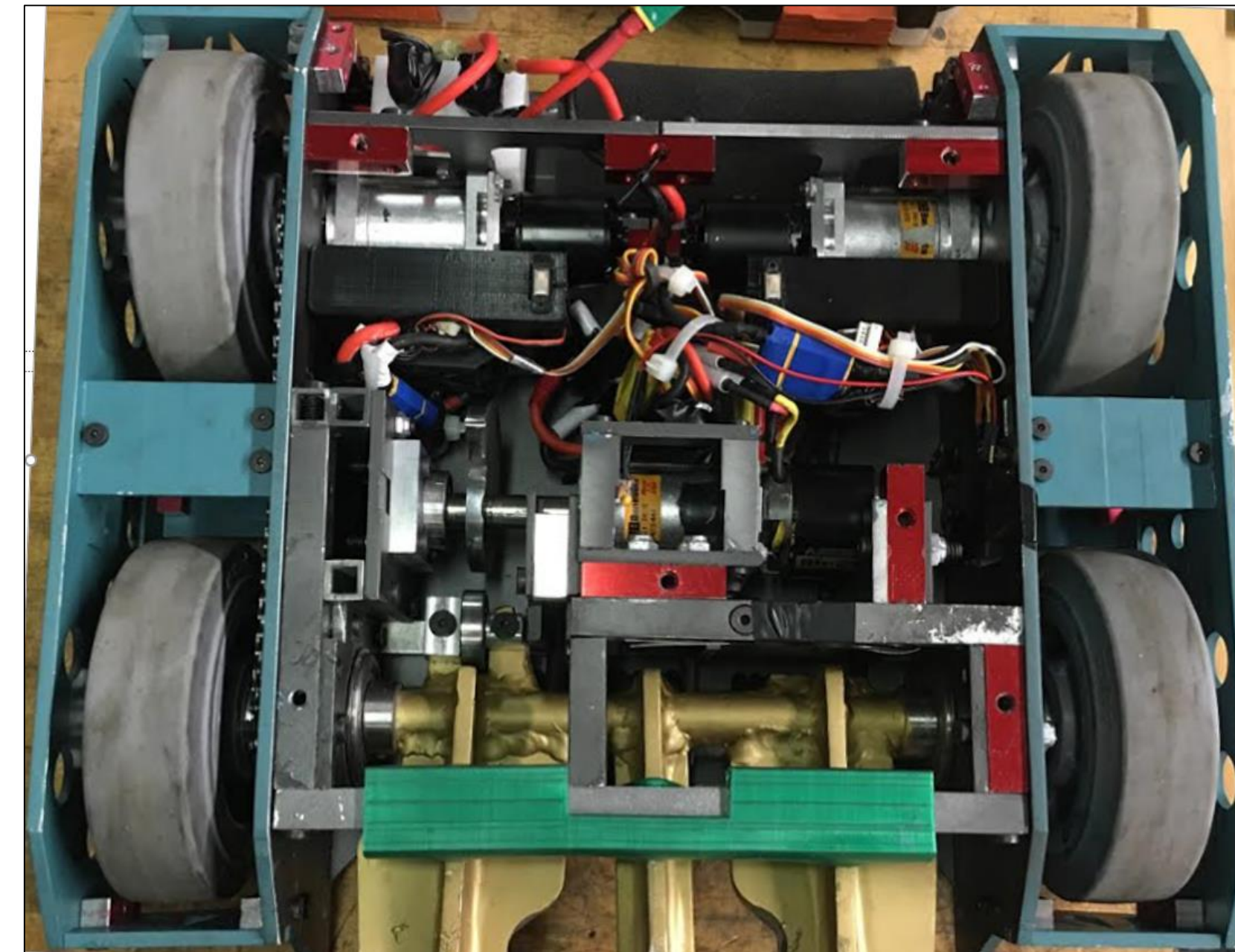
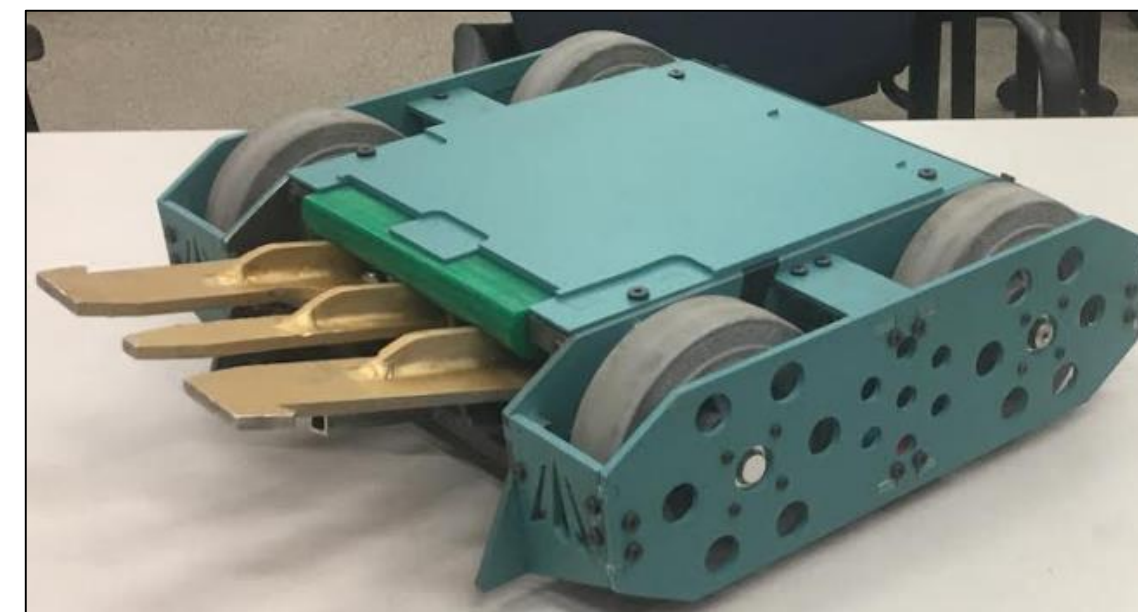
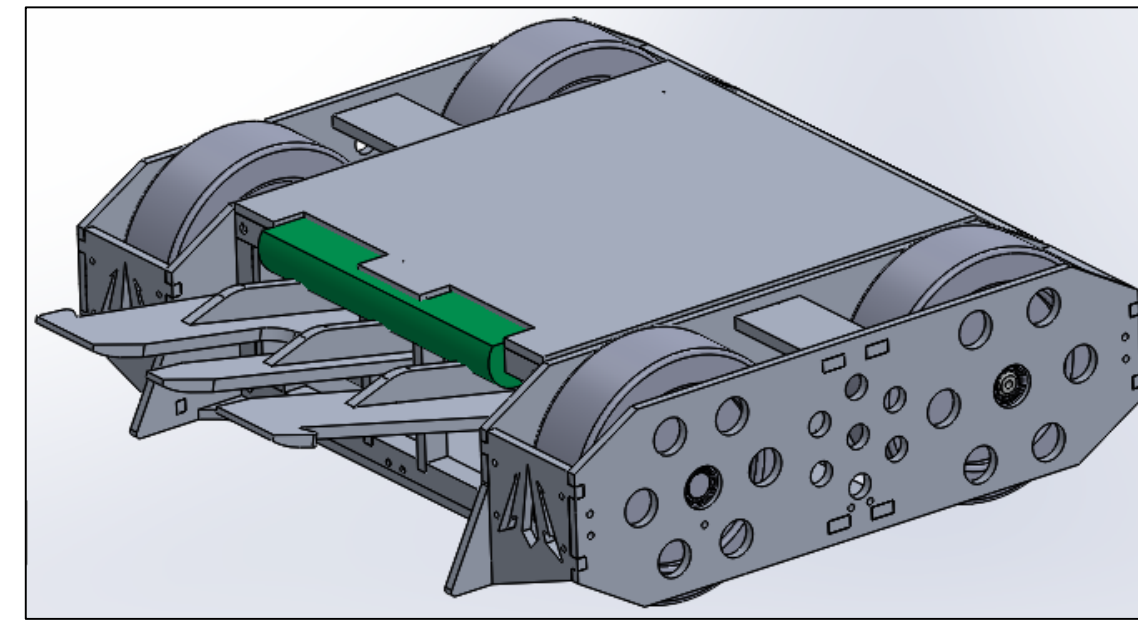
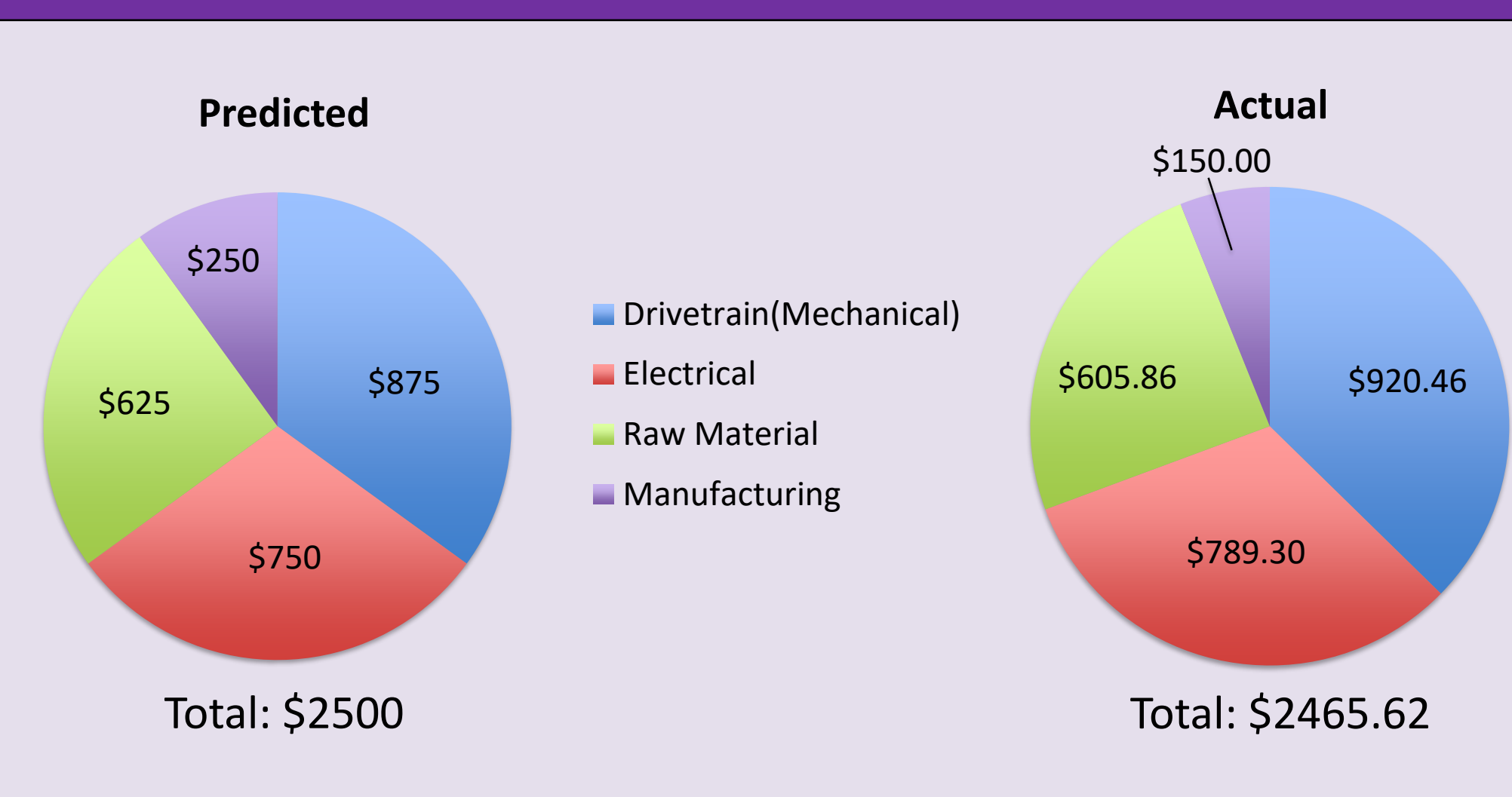
## Background

Robot Battles are robotic combat competitions held around the globe. The competitions started in 1991 and are mostly held in the United States. The competitions feature four weight classes: up to one pound, one to three pounds, three to twelve pounds, and twelve to thirty pounds. For the past few years, LSU has been hosting an annual 30lb combat robot Bengal Bot Brawl on campus. The competition is held every spring and puts four teams to the test, three capstone teams and one robotics club team. The winning team is then sent to compete in a national competition, hosted by [Robot Battles](#), within the next calendar year.

## Design Specifications

Specification	Value
Weight	30 lbs.
Maximum Speed	9 ft/s
Dimensions	17.00 in x 15.38 in x 5.00 in
Flipping Force	60.55 lbf
Battery Life	9 minutes

## Budget \$2500



## Chassis

**Material:** 7075 Aluminum and 6061 Aluminum  
**Thickness:** 0.20 in +/- 0.05 in  
**Dimensions:** 17.00in x 15.38 in x 5.00 in

- Holes added to reduce weight
- Front planters added to prevent flipping forward during weapon activation.
- Plates joined using 10-24 & 1/4-20 nutstrips

## Power

**Battery:** Turnigy Graphene Panther

- Capacity: 4000 mAh
- Voltage: 4S – 14.8 V
- Discharge: 75C/150C Burst

**Power Switch:** Team Whyachi MS-2

**Fuses:** 50 Amp fuses are implemented on the drive ESCs to provide overcurrent protection.

## Testing and Validation

Test Type	Predicted	Pass/Fail	Value
Impact	3 ft Drop	PASS	4.25 ft
Static Coefficient of Friction	1.0	FAIL	0.8
Torsion Spring Deformation	65°	PASS	80°
Weight	30 lbs + 2.5%	PASS	28.6 lbs
Driver Selection	N/A	N/A	Robert
Master Power Switch	Power On/Off	PASS	N/A
RC Failsafe	Cease Operation	PASS	N/A
Output Torque (Drive/Weapon)	> 72.2 in-lbs/420 in-lbs	PASS	138.6 in-lbs/504 in-lbs
Max Velocity	< 9 ft/s	PASS	7 ft/s
RC System Response	Control Precision	PASS	N/A
Max Temperature	< 180°F	PASS	107°F

## Drivetrain

**Wheels:**

- Diameter = 5 in
- Width = 1.5 in

**Sprockets:**

- 4 Aluminum sprockets with 16 teeth and 1.41 in outer diameter.

**Chains:**

- Carbon steel chain with 0.25 in pitch size.

**Gearbox:**

- P60 Gearbox, standard
- 38:1 gear ratio

**Motors:**

- 2 Propdrive v2 3548 900KV Brushless Outrunner Motor
- Max Voltage: 17.0 V
- Rated Torque: 5.16 in-lbs

**ESC's:**

- Mamba Monster X ESC.

## Control

**Receiver:**

- Located inside robot
- FrSky X4RSB 3/16CH Telemetry Receiver Full Range
- Operating Voltage: 4-10 V
- Operating Current: 100mA at 5V

**Transmitter:**

- Handheld Controller
- FrSky 2.4G ACCST Taranis Q X7 16 Channel

**Microprocessor Board:**

- Arduino Uno Rev 3 with Headers
- # of Digital Input/Output: 20
- Operating Voltage: 5 V
- Input Voltage: 7-12 V.

**Thermocouple PCB:**

- Two thermocouple inputs
- Temperature range:

## Weapon

**Torsion Spring:**

- Quantity: 3
- Wire Diameter: 0.250 in +/- 0.0010
- Outer Diameter: 1.600 in +/- 0.040
- Inside Diameter: 1.100 in +/- 0.040
- Spring Leg Length: 4 in
- Maximum Torque: 225.764 in-Lbs

**Planetary Gearbox:**

- P60 Gearbox, standard
- 64:1 gear ratio

**Brushless Motor:**

- Propdrive v2 4248 650kV Brushless Outrunner Motor
- Voltage: 19.0 V
- Rated Torque: 9.10 in-lbs

**Brushless ESC:**

- YEP 80 Amp ESC

**Frame:**

- 6061 Aluminum
- 7075 Aluminum

## Manufacturing

- Aluminum was ordered in 0.20 inch and 0.25 inch sheets, then the sheets were cut to the appropriate dimensions using the waterjet, bandsaw, and mill.
- 7075 Aluminum parts were joined using 10-24 and 1/4-20 nutstrips from Fingertech Robotics.
- The weapon flipper was made using a 12 in x 12 in x 0.25 in sheet of 6061 Aluminum and a 12 in x 0.75 in rod of 6061 Aluminum. The pieces were permanently joined together by welding.
- The drivetrain features 3D printed brackets used to join the motors, gearboxes, and electronic speed controllers into one independent subassembly.

September

Concept Generation

October

Selection and Refinement

November

Develop Final Design

December

Order Components

January

Start Assembly

February

Start Testing Sub-Systems

March

Finish Assembly

April

Finish Testing LSU Competition

May

National Competition

Sponsors: Mr. Jack Rettig

Advisers: Dr. Hunter Gilbert, Mr. Gabriel DeSouza