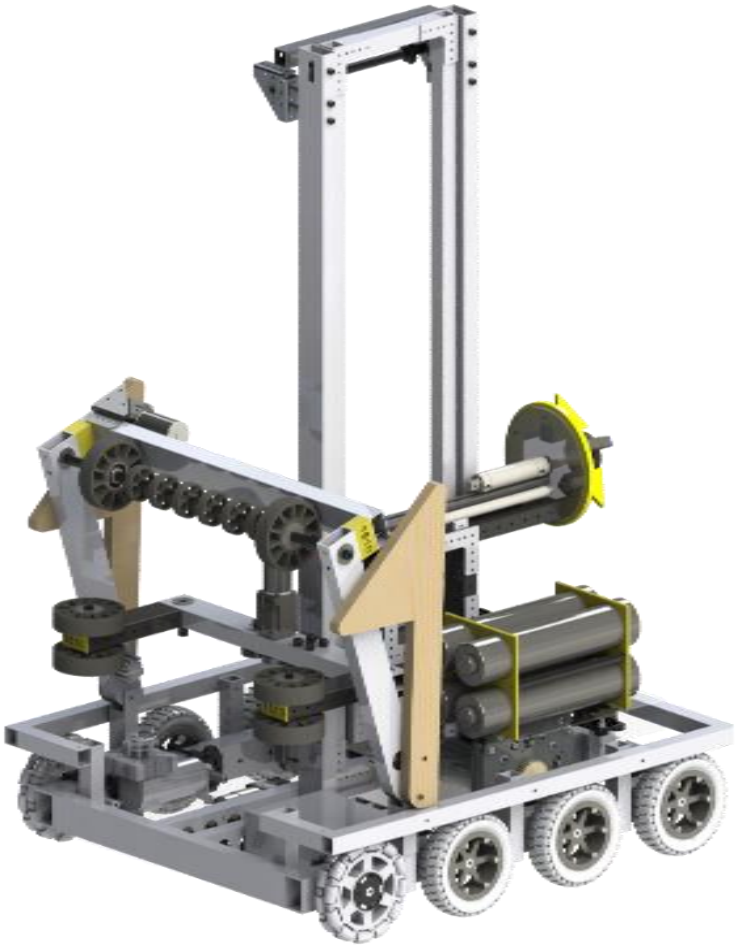
2019

“Tuscarora” Technical Binder



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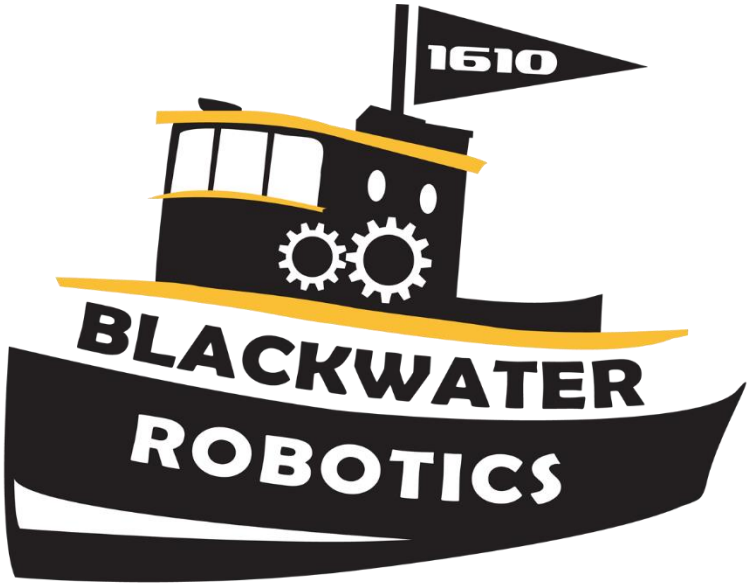
BLACKWATER ROBOTICS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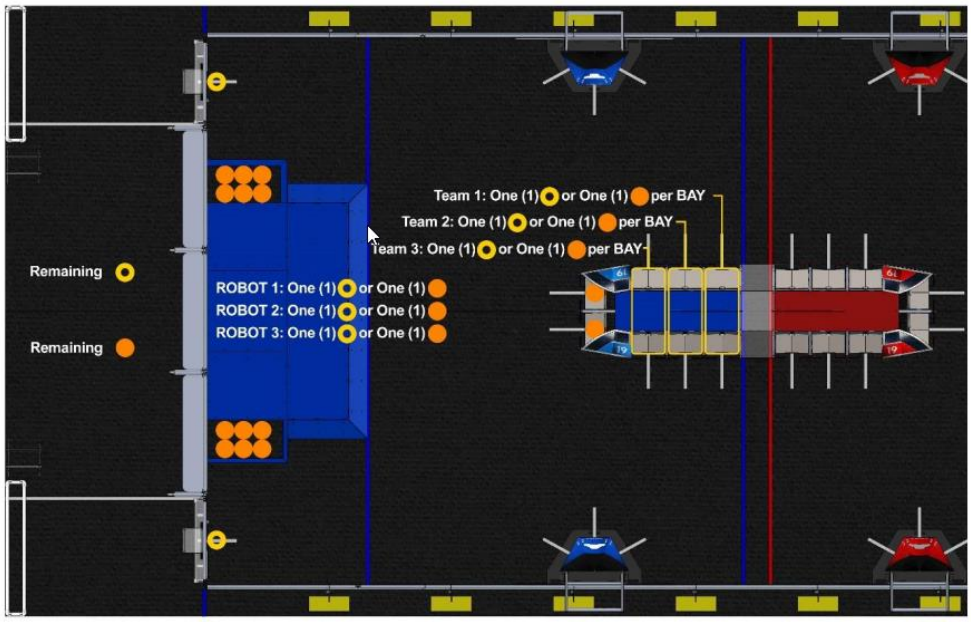
GAME ANALYSIS



Award	Awarded for…	Value
SANDSTORM Bonus 1	each ROBOT whose BUMPERS fully cross the HAB LINE during the SANDSTORM PERIOD. Value corresponds to the Level from which the ROBOT started.	3
SANDSTORM Bonus 2		6
HATCH PANEL	each HATCH PANEL (excluding Null HATCH PANELS) attached to a ROCKET or CARGO SHIP such that it is fully supported by that ROCKET or CARGO SHIP and via the hook/loop tape (contact by an opponent ROBOT does not count as "support" and does not negate a scored HATCH PANEL). No more than one HATCH PANEL per HATCH will be counted.	2
CARGO	each CARGO (regardless of inflation state) in a BAY with a Null HATCH PANEL or scored HATCH PANEL and not in contact with a ROBOT from that ROCKET/CARGO SHIP'S ALLIANCE. No more than one CARGO per BAY will be counted.	3
HAB Climb Bonus: Level 1	each ROBOT which has climbed their HAB PLATFORM (value corresponds to the Level to which the ROBOT has climbed). A ROBOT whose BUMPERS haven't fully crossed their HAB LINE to leave their HAB ZONE at any point during the MATCH isn't eligible.	3
HAB Climb Bonus: Level 2		6
HAB Climb Bonus: Level 3		12
HAB Docking	earning at least fifteen (15) HAB Climb Bonus points.	1 Ranking Point
One (1) Complete ROCKET	completing at least one (1) ROCKET with six (6) scored HATCH PANELS and six (6) scored CARGO	1 Ranking Point
Tie	Completing a MATCH with the same number of points as your opponent.	1 Ranking Point
Win	Completing a MATCH with more points than your opponent.	2 Ranking Points

Destination: DEEP SPACE

DEEP SPACE is an intriguing game with two vastly different game pieces. Teams must first place Hatch Panels onto cargo bays, then insert a Cargo to score maximum points. This is the first game since 2011 that requires game pieces to be scored in a particular order. Efficient manipulation of both game pieces will be critical to our success.

On the second day of build season we invited local teams to our shop to discuss game strategy and play a "human game." These scenarios helped the teams in attendance to see how a full 3 vs 3 match might play out.

Visiting teams use our stock of wheels to determine what texture works with best with the new game piece.

Through using different scenarios to play simulated matches, we came to some conclusions:

- Visibility on the field is limited due to the shape of the Cargo Ship and far side of the Rocket. Having a camera on the robot is critical.
- While only one defensive bot is allowed, defending a single Rocket would be easy to stop opponents from gaining an extra Ranking Point.
- From initial discussion, many teams undervalued the Rocket, so we wanted to fill that need and be able to score all Hatch Panels and Cargo available in the Rocket.

Build and Game Strategy

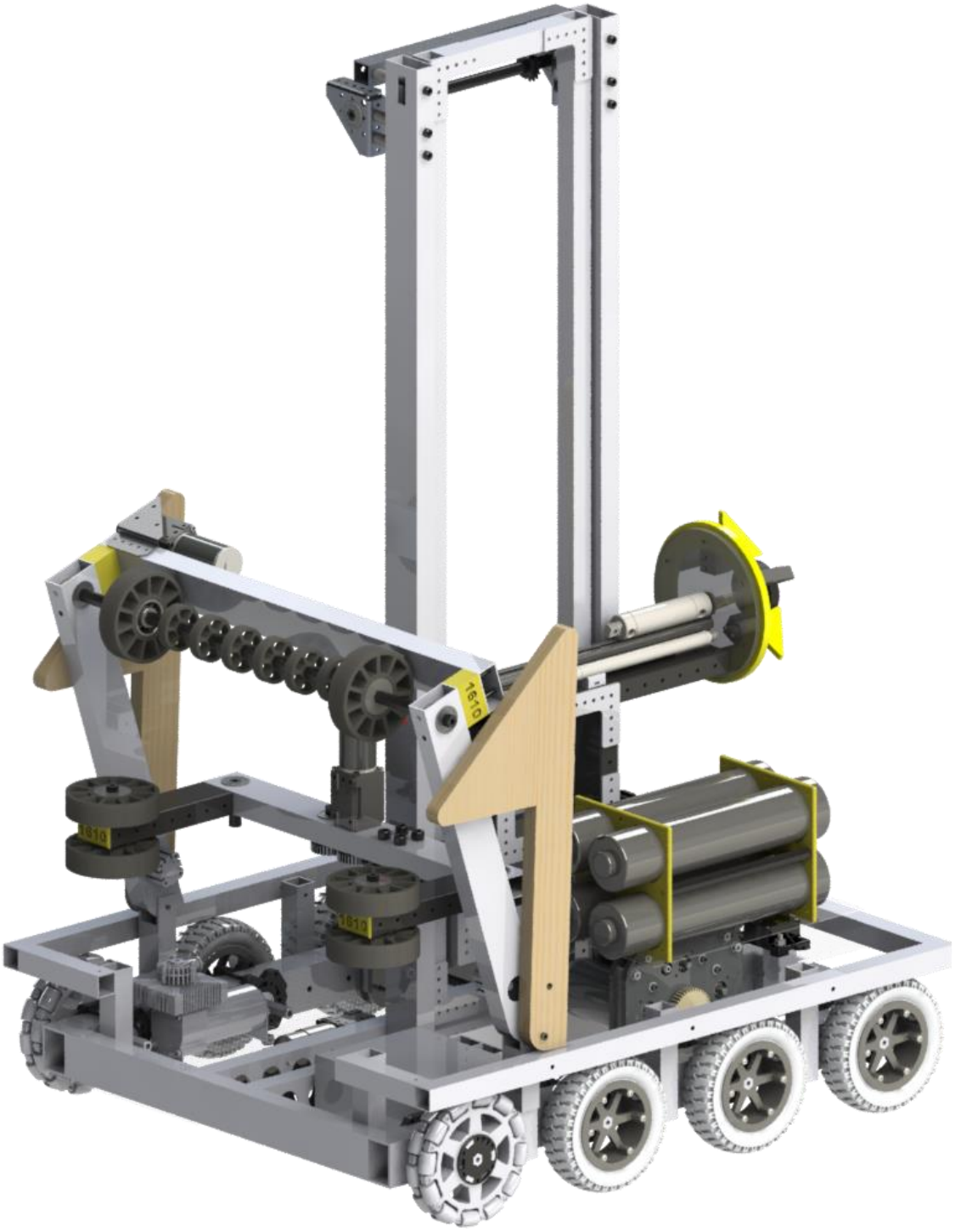
Our top priority is to rank as an alliance captain by winning matches and gaining extra Ranking Points. We decided early on to skip HAB 3 and only build to climb to HAB 2, but this means we must rely on alliance partners to help obtain both the HAB and ROCKET Ranking Point bonuses.

While scoring the HAB Ranking Point will be more common, we will focus as much as possible on filling the ROCKET to obtain the more rare second Ranking Point.

Design Priority List

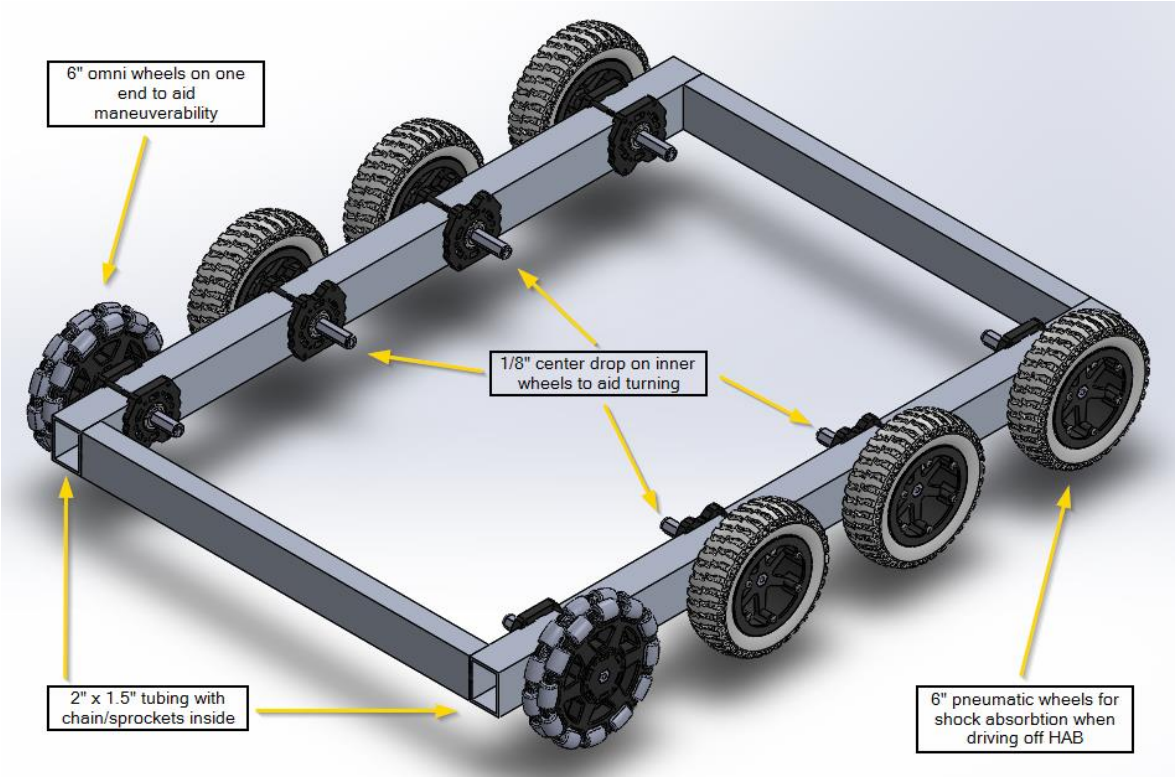
1. **Drivetrain**
    a. Fast and powerful
    b. Lightweight but strong
    c. Low center of gravity but adequate ground clearance for the HAB
2. **Hatch Panel Manipulator**
    a. Must be very secure, no accidental drops
    b. No ground pickup, but should reach all ROCKET levels. Lowest point 19".
3. **Cargo Intake**
    a. "Touch-it, own-it" intake. Don't struggle to obtain CARGO.
    b. Handoff to lifting mechanism to reduce vertical weight.
4. **Lifting mechanism**
    a. Elevator or pivoting arm
    b. ROCKET level 3 CARGO height – 83"
5. **Sandstorm**
    a. Camera crucial to operator control
    b. Vision tracking beneficial
    c. Multiple reliable autonomous modes
        i. Cargo Ship
        ii. Left/Right rocket
        iii. Obtain additional HATCH PANEL from HP station
6. **Climbing Habitat**
    a. Skipping HAB 3, don't feel we can accomplish this along with the full ROCKET
    b. Develop ramp device to lift front of robot to HAB 2, then drive up

DESIGN

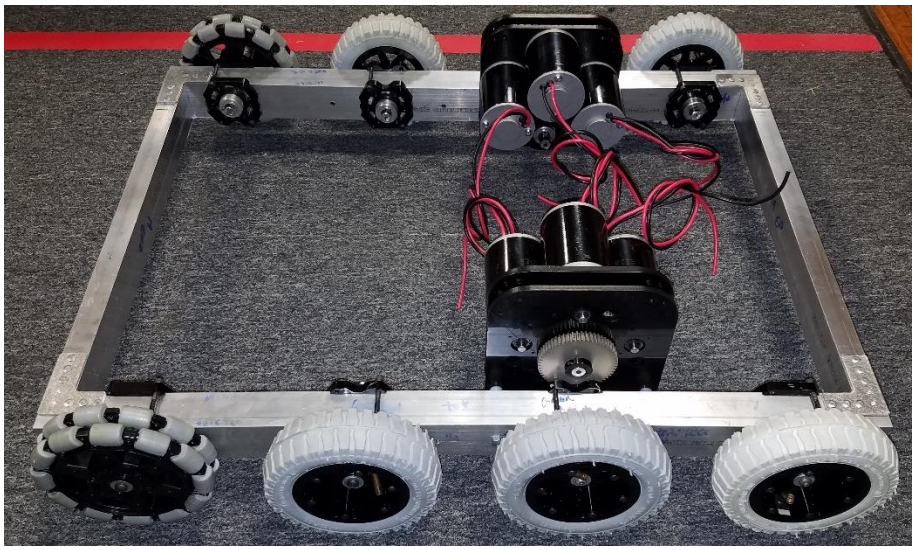


Chassis

The drive chassis is constructed in the West-Coast style that we have used in previous seasons. West Coast Drive places the wheels on the outside of the frame. This familiar style provided a design advantage when coupled with wider 2” x 1.5” aluminum tubing for the drive rails so that chain and sprocket could be run inside the tubing from the driven axle to remaining front and rear axles. While utilizing the chain-in-tube design that we also used 2016-2018 serves to save space, construction has to be precise since the chains are not easily maintained.



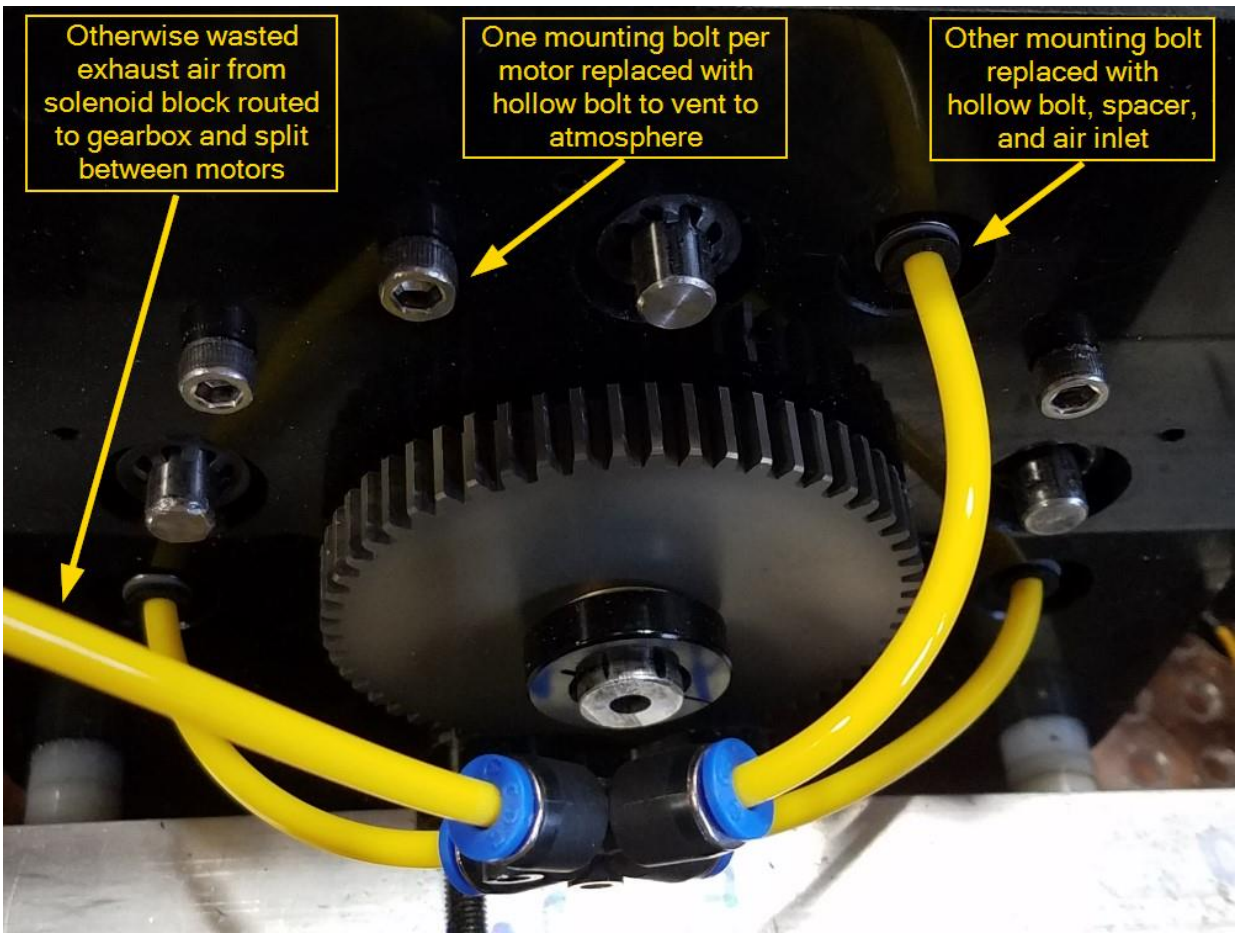
A small center drop on the two center axles, created by flipping the orientation of the Versa Block sets, assists with turning the eight wheel chassis, our first eight wheel design since 2012.



Air Cooled Gearboxes

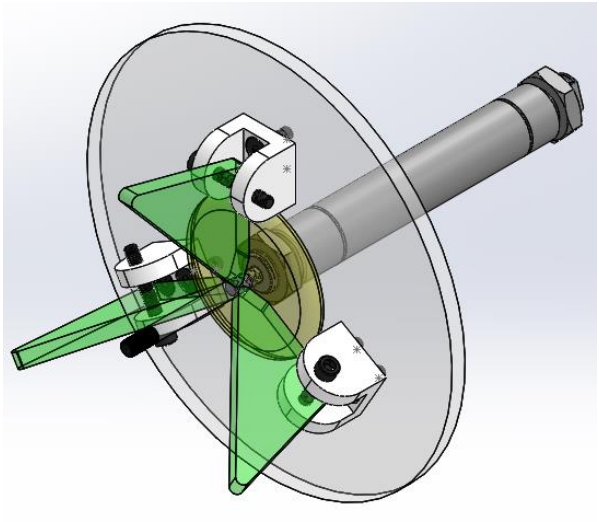
In collaboration with Team 2363 – Triple Helix, we are using completely custom two stage reduction gearboxes. We first used these in the 2018 season to great success. Typical CIM motors were replaced with Mini-CIMs to save weight and space. There is evidence from discussion by Vex Robotics engineers that a six Mini-CIM drive should have better performance on a robot in match conditions.

Included in the gearboxes are 5/32” pneumatic inlets and vented mounting bolts. This combination allows air discharged from our pneumatic cylinders, which would normally be wasted, to flow through the motors as a passive cooling process.

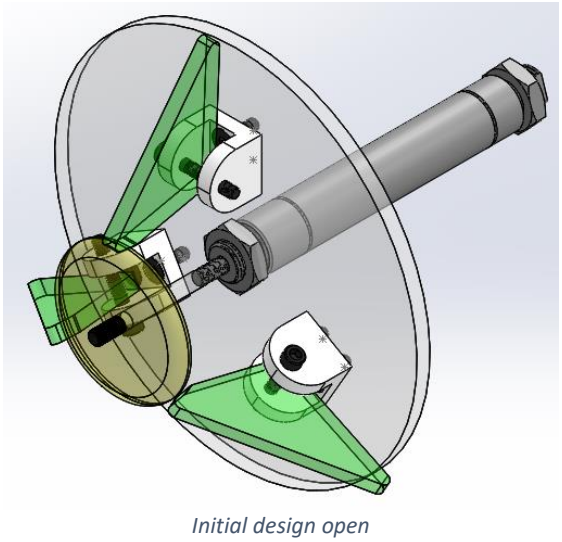


Hatch Manipulator

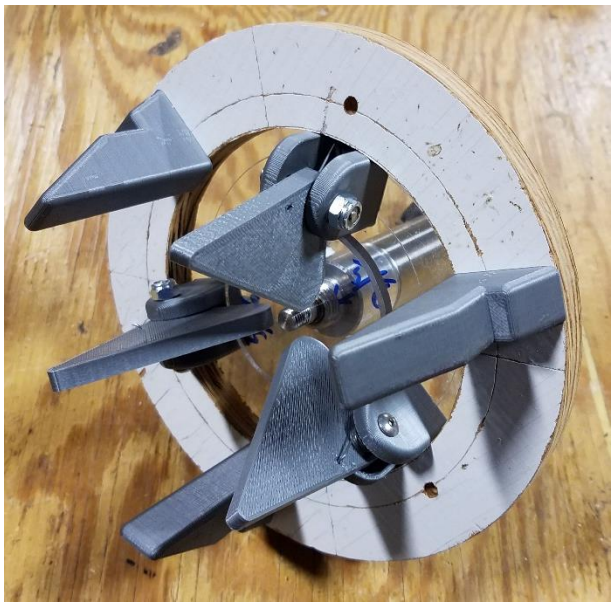
After initial tests of a suction cup based design fell short, we began work on iterating a mechanism designed by Team 2363 in the 2015 season for grasping the inside of the recycling can. This mechanism uses a pneumatic cylinder to push a plunger that actuates triangular fingers on a pivot. The fingers retract by the force of a torsion spring attached to both the fingers and their pivot mounts. The entire mechanism was quickly prototyped with 3D printed parts.



Initial design closed



Initial design open

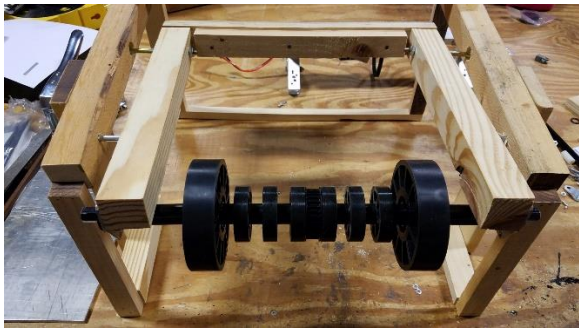


First printed prototype

Second version

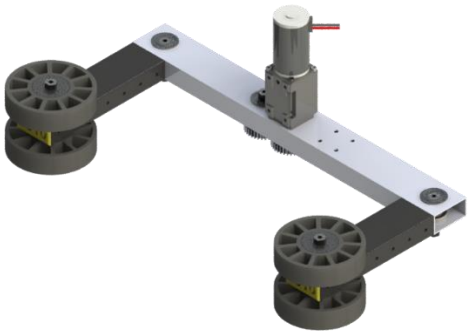
Cargo Intakes

Working from ideas based on a mix of our 2014, 2016, and 2018 intake designs, we prototyped a few different cargo intakes, ultimately deciding on a “handoff” system that uses one intake to extend out over the bumpers and hand off the Cargo to a gripper attached to the elevator carriage. This adds weight initially, but reduces the weight travelling up the elevator and we saw many teams succeed with this type of handoff in 2018.



"Floating" intake prototype

Over the bumper intake



1 Cargo gripper - elevator mounted

Elevator (next page)

Elevator

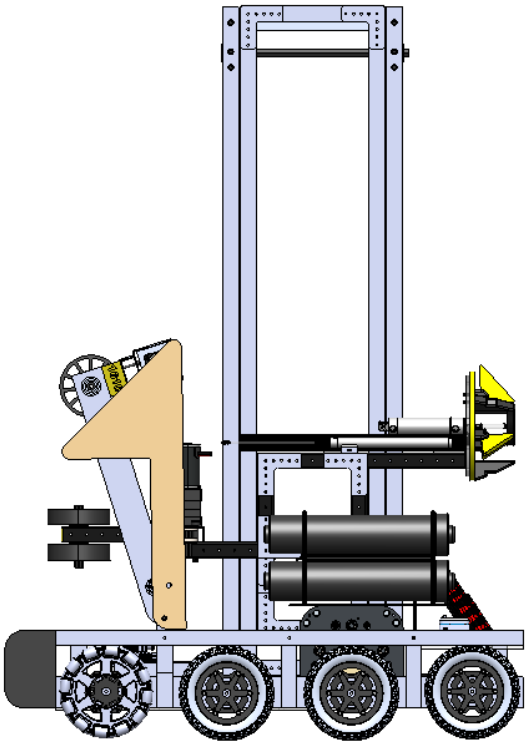
Improving on our elevator design from the 2018 season, we utilized 1/16” aluminum tubing to reduce weight, and the first stage of the elevator is made from 1” by 1” square tubing to reduce weight even further. These upgrades resulted in a reduction of nearly 50% of weight from the elevator mechanism. The elevator carriage features two pneumatic cylinders to slide both the hatch manipulator and cargo handoff out into scoring position over the bumpers.

Habitat Level 2

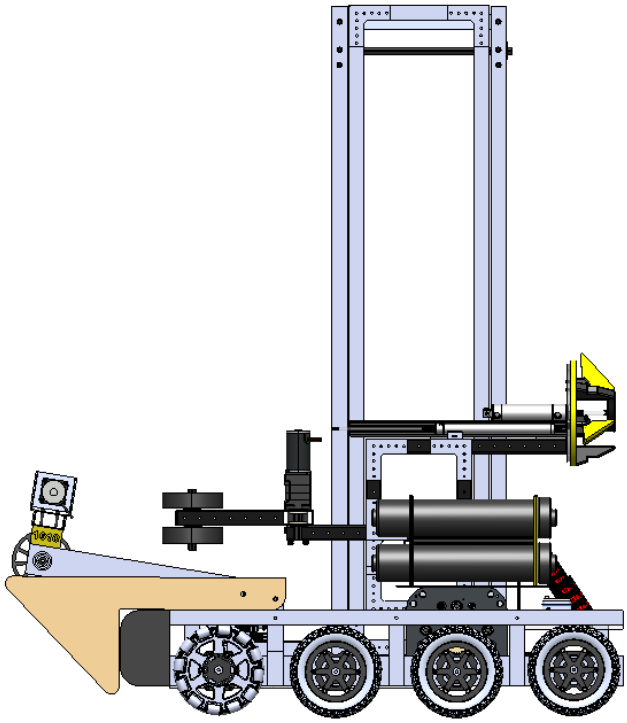
With an eight wheel drivetrain and proper gearing, we have enough power to simply drive up onto Habitat Level 2, but had to design a way to overcome the 6 inch step up. After initially prototyping with multiple pneumatic cylinders, we didn’t want to risk bending a cylinder.

Our final design utilizes two wedges, one on each side of the intake, that come down over the bumpers and create the proper angle for our bumpers and frame to clear the HAB and to contact the first wheel. Once the first wheel makes contact we simply drive up.

On both sides of the intake is a pancake cylinder with a pin. This pin holds the wedges upright for the duration of the match, then allows the wedges to drop into position. The intake is then lowered and the pins fire back into the center of the wedges, holding them in place.



Wedges upright

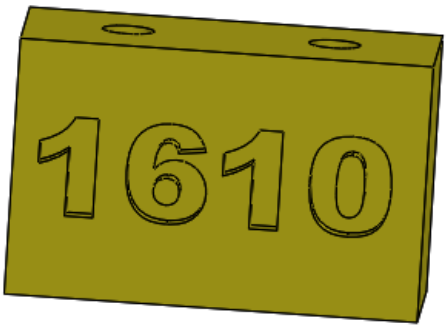


Wedges deployed

3D Printed Parts

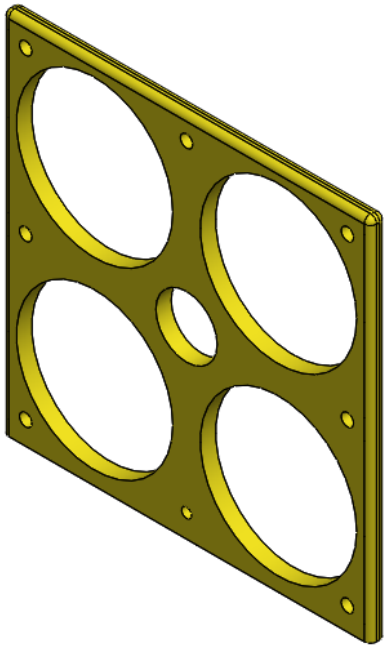
Thanks to a recent grant from International Paper, we were able to purchase two 3D printers during the 2018 off-season. We have used them extensively, printing both community designed objects and creating our own designs. Parts we designed and printed that are included on the robot are:

- 2x1 End caps
- Air tank mount
- Anderson PowerPole clips
- Custom sized spacers
- Hatch manipulator assembly
- Magnetic Reed Switch mount
- Pneumatic cylinder cradle
- Power Distribution Panel mount

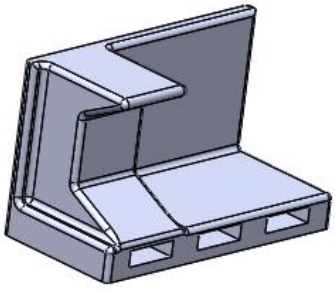


Custom sized spacers

Power Distribution Panel mount



Air tank mount



Magnetic Reed Switch mount

PROGRAMMING AND CONTROLS

Each side of the drivetrain is controlled by one Talon SRX master and two Victor SPX in “follow” mode. Utilizing follow mode, each master controller is programmed then the followers communicate with the master over CAN (Controller Area Network) to get their instructions.

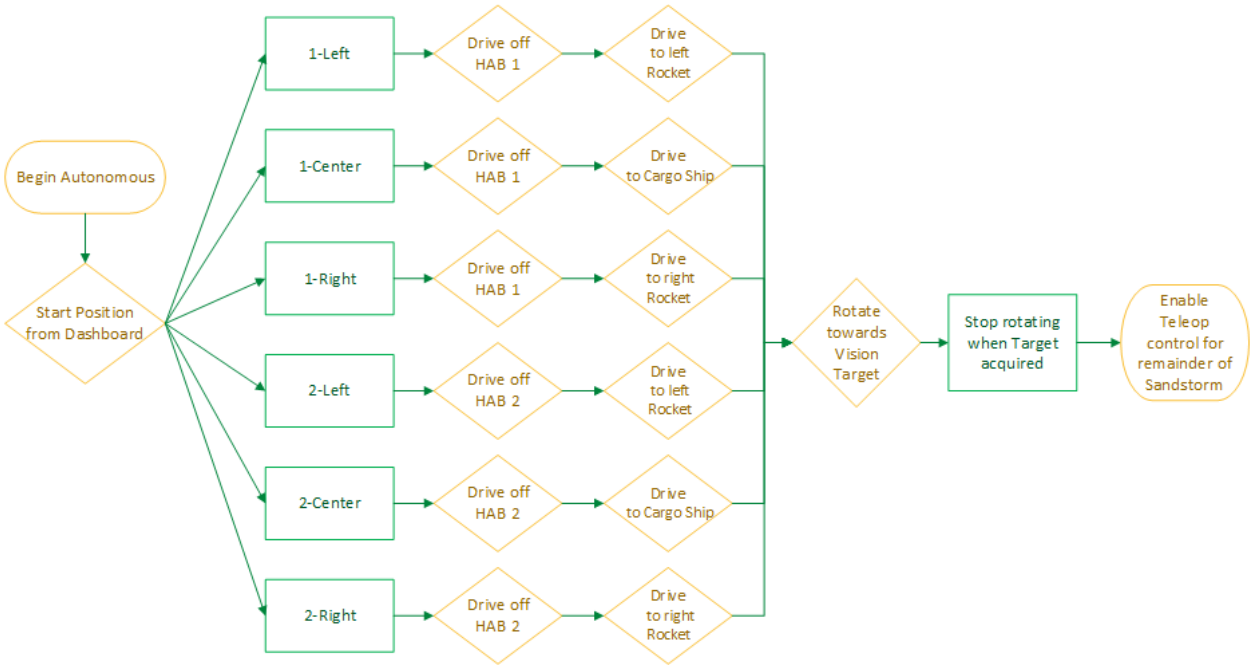
Quadrature encoders for straight driving when coupled with PID control in autonomous are connected to the Talon SRX utilizing the built-in data port and encoder breakout board.

Voltage Compensation is enabled for the drivetrain motor controllers, limiting top-end speed but increasing reliability. 100% throttle is pushed to the motors as 10.5 volts rather than 12 volts providing a more reliable experience as voltage diminishes through the match.

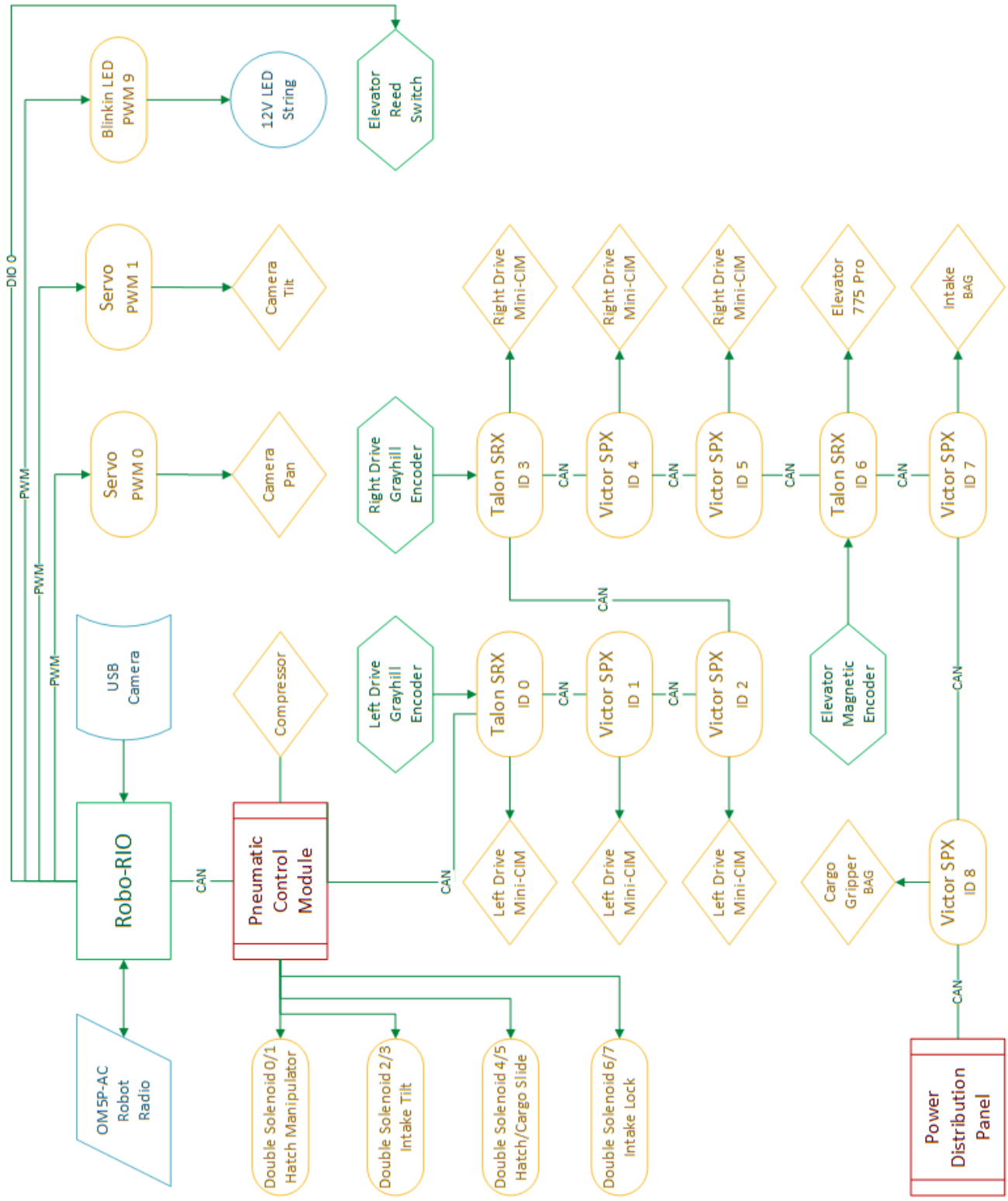
An integrated encoder on the elevator lift motor gearbox prevents top-end jams while a magnetic limit switch at the lowest elevator point resets the encoder count each cycle for higher accuracy.

LED lights on the elevator and around the robot provide quick visual feedback to the driver and operator by changing colors when drive direction is reversed.

Autonomous Program Selection Flowchart



Communications Schematic



BLACKWATER ROBOTICS

Team History

Based out of Franklin High School, our team was founded in 2005 as the Builders of Tomorrow (BOT) by *FIRST* LEGO League coach Liz Burgess after seeing a nearby school compete at the 2004 NASA/VCU *FIRST* Robotics Competition Regional. BOT stormed onto the scene in 2005 as the Highest Rookie Seed, Rookie All-Star, and made an appearance at the World Championship in Atlanta. After this strong start, the team never looked back.

With a history of low funding, a rural city school system that has few interested students and no technical programs, and a consistent lack of engineering mentors, we have continued to succeed in competition with much larger teams. Our team is made up of students from 8th-12th grades in Franklin City Public Schools.

Re-branded in 2017 as Blackwater Robotics, we take pride in our local history and hope to soon expand our program to nearby schools.

Accomplishments

2018	*FIRST* Chesapeake Hampton Roads Event	Excellence in Engineering
2018	*FIRST* Chesapeake Central VA Event	Event Winner
2018	*FIRST* Chesapeake Central VA Event	Quality Award
2017	*FIRST* Chesapeake Hampton Roads Event	Event Winner
2017	*FIRST* Chesapeake Hampton Roads Event	Quality Award
2015	Chesapeake Regional	Event Finalist
2015	Virginia Regional	Event Winner
2014	Chesapeake Regional	Event Finalist
2014	Chesapeake Regional	Quality Award
2014	Virginia Regional	Event Winner
2013	Virginia Regional	Event Winner
2007	NASA/VCU Regional	Event Finalist
2006	NASA/VCU Regional	Event Winner
2005	NASA/VCU Regional	Rookie All-Star
2005	NASA/VCU Regional	Highest Rookie Seed

Blackwater Tugboat History

By Clyde Parker

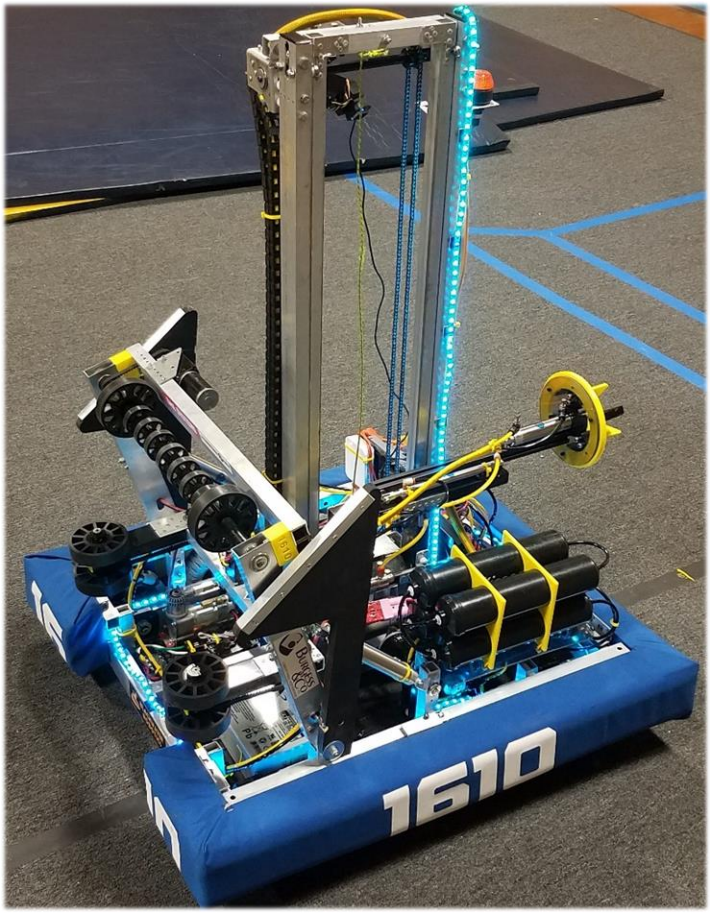
On Nov. 1, 1937, when Chesapeake-Camp Corp. started producing paper, in Franklin, a newly formed "River Operations" department was organized to help supply the mill with pulpwood, which was to be accumulated at Winton, North Carolina from that area's pine woodlands, by pulling barges loaded with pulpwood up the Chowan and Blackwater rivers to Franklin. Barges were acquired. A tugboat was needed.

In response to that need, in early 1938, a steam-powered tugboat named "Corinthia," built in 1890 in Philadelphia, was purchased and put into action with Harry B. Ward Sr. as its captain. "It was a ragged-looking thing," Harry Ward Jr. recalled for an article in the Spring 1999 edition of Union-Camp's magazine, "The Log." The tugboat had been in disuse for several years prior to being purchased and refurbished by Chesapeake-Camp.

In 1970 a tugboat by the name of "Convoy," originally built for the United States Army Corps of Engineers, joined the Union Camp tugboat fleet. Soon after its purchase, it was re-named the "Cotton J" in honor of J.B. "Cotton" Johnson who was, at that time, manager of Union Camp's Woodlands Division, operating out of Franklin.

Southampton County Sheriff Jack Stutts, grandson of "Cotton" Johnson, son of the late Joe Stutts of Union Camp, and son of the late Carolyn Johnson Stutts, remembers the "Cotton J" well. "I used to take rides up and down the Blackwater and Chowan rivers on the 'Cotton J' with my grandfather," he said recently. "And I rode on some of the other tugs; they were all exciting experiences, but, of course, I liked 'Cotton J' the best."

Though smaller than its predecessor, the "Cotton J" kept river operations going until 1972 when a newer tugboat, the "**Tuscarora**," was put into service. It was named after an Indian tribe that lived along the Chowan River.



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